RADIO SET AN/PRC-70 ()

C. A. Bucher

Cincinnati Electronics Corporation

Prepared for:

Army Electronics Command

August 1975

80045-PRC41/875

AD

RESEARCH AND DEVELOPMENT TECHNICAL REPORT

ECOM-0319-9

RADIO SET AN/PRC-70 ( )

NINTH QUARTERLY REPORT

BY

C.A. BUCHER

AUGUST 1975

Approved for public release;
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ECOM

U.S. ARMY ELECTRONICS COMMAND · FORT MONMOUTH, N.J.

CONTRACT DAAB07-71-C-0319

CINCINNATI ELECTRONICS CORPORATION
CINCINNATI, OHIO 45241

Successor by Purchase
of the Evendale Operation
of the AvcoElectronics Division

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY *(Corporate author)*
Cincinnati Electronics Corporation
2630 Glendale-Milford Road
Cincinnati, Ohio 45241

2a. REPORT SECURITY CLASSIFICATION
Unclassified

2b. GROUP

3. REPORT TITLE

Radio Set AN/PRC-70( )

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Ninth Quarterly Report - 1 January 1975 to 31 March 1975

5. AUTHOR(S) *(First name, middle initial, last name)*

C. A. Bucher

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
August 1975	69	

8a. CONTRACT OR GRANT NO	9a. ORIGINATOR'S REPORT NUMBER(S)
DAAB07-71-C-0319	80045-PRC41/875
b. PROJECT NO. 1S6-67401-D-535-01	
c.	9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)* ECOM-0319-9
d.	

10. DISTRIBUTION STATEMENT

Approved for public release; distribution unlimited

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U.S. Army Electronics Command Ft. Monmouth, New Jersey 07703 AMSEL-NL-E-4

13. ABSTRACT

This report covers the quarterly interval from 1 January 1975 through 31 March 1975. The effort expended during this period was mainly directed toward the Qualification Tests of the equipments.

DD FORM 1 NOV 1473

UNCLASSIFIED

Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
HF/VHF Radio Tuner, Synthesizer Power Amplifier						

TR-ECOM-0319-9
August 1975

Reports Control Symbol
OSD-1366

RADIO SET AN/PRC-70 ( )

NINTH QUARTERLY REPORT
1 January 1975 to 31 March 1975

CONTRACT NO. DAAB07-71-C-0319

DA PROJECT NO.
1S6-674701-D-535-01

DISTRIBUTION STATEMENT

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1.0 SYSTEM STATUS

The ET/ST Systems have been fabricated and Acceptance Testing has been completed. While the Acceptance Test units are being refurbished, the Reliability Automatic Test Set is being debugged.

1.1 SYSTEM TESTS

The following data has been accummulated on the 21 ET/ST Systems. The data was taken according to the Acceptance Test procedure at room temperature. Although much more data has been accumulated during this period, only the more significant or improved data is being indicated.

1.1.1 Input Power

Figures 1 through 6 are graphs showing the input current required versus frequency for the various systems and modes of operation and for the nomenclatured systems. All data was taken at +24 VDC. The power data is the current required to deliver approximately 30 watts of RF power to a 50 ohm load. The lower power mode (3 watts) and the receiver data was taken in CW mode. Maximum input power required is 160 watts in CW mode at the low end of the frequency range (2 - 4 MHz) where the output RF power is close to 40 watts. The typical power required is 130 watts.

1.1.2 Power Output

Figures 7 through 12 show the transmit power output for the indicated modes of operation. In general, the power output averages very close to 30 watts with maximum power at the lower end of the frequency range and minimum power at 35 MHz. The variation in power is due primarily to two factors: 1) the gain of the ALC loop and, 2) the presence or lack of losses in the antenna coupler. As indicated on the charts, the AME power is low due to the set-up in the ALC module for AME mode. The problem has been resolved and the units now run identical to SSB 2-tone operation.

1.1.3 Sensitivity

Figures 13 through 31 show the output S + N + D/ N + D for input signals as shown below:

SSB, CW, FSK — .5 μV (2 - 20 MHz)
— .375 (20 - 76 MHz)

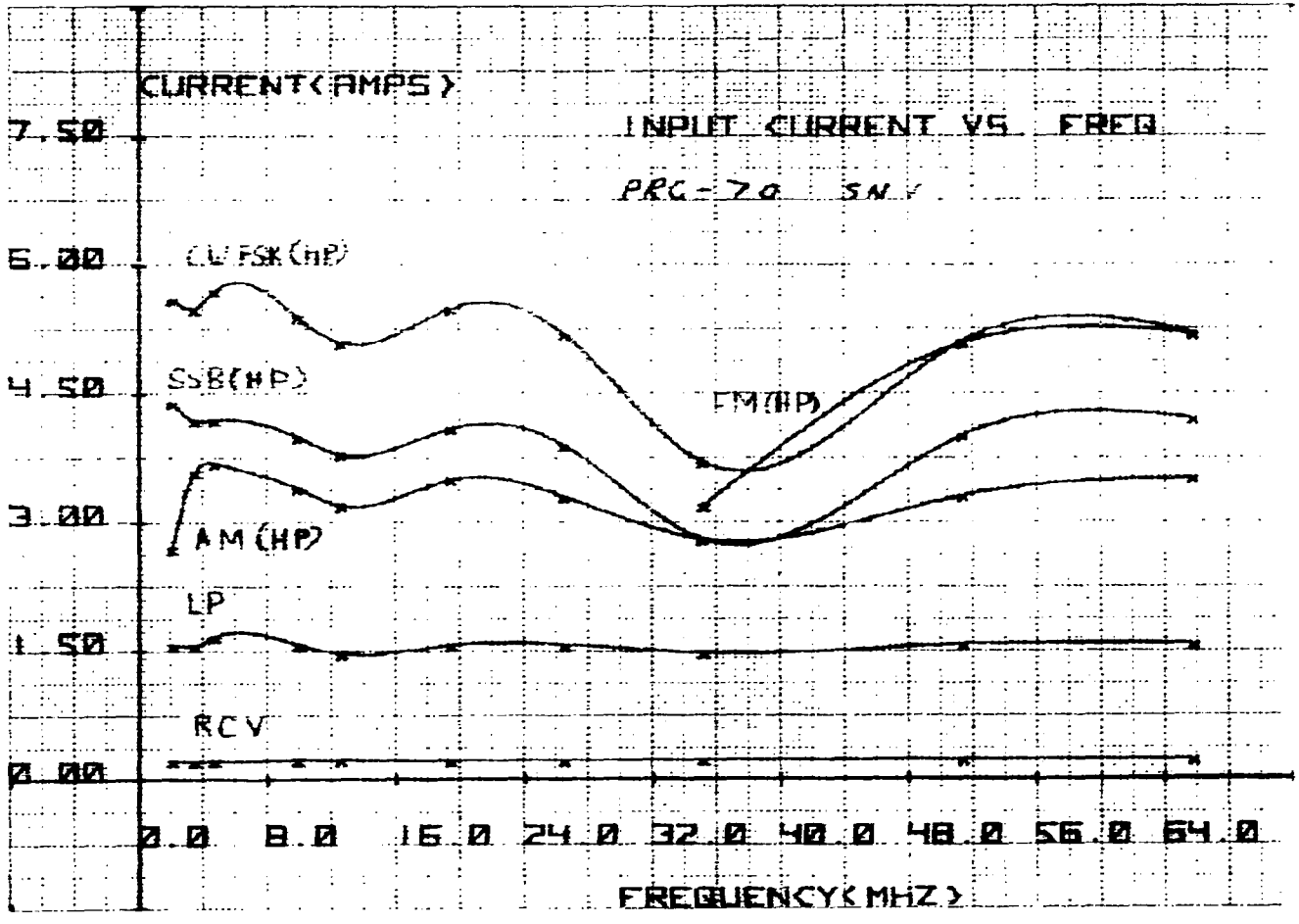


Figure 1. Input Current vs. Frequency - PRC-70 S/N 1

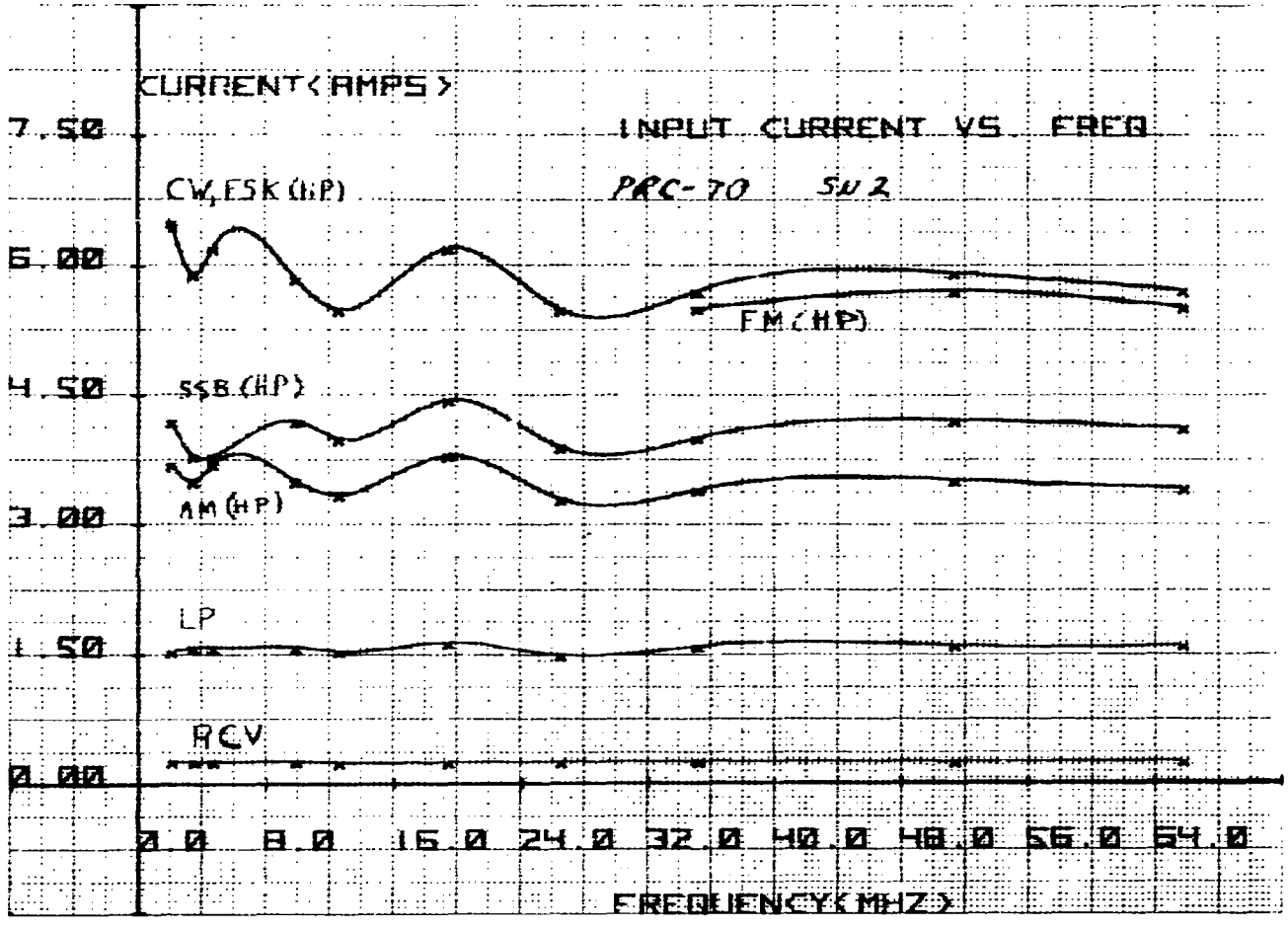


Figure 2. Input Current vs. Frequency - PRC-70 S/N 2

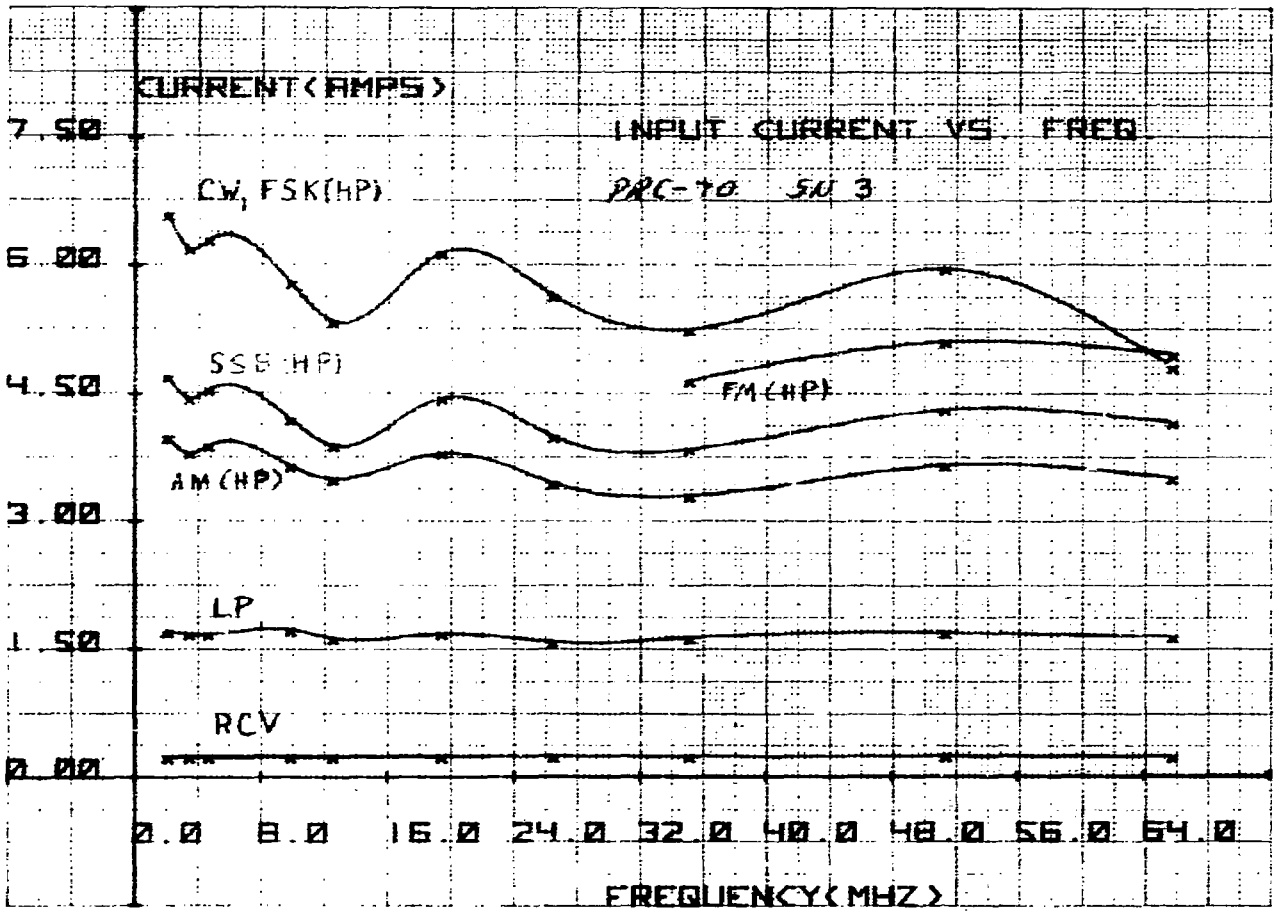


Figure 3. Input Current vs. Frequency - PRC-70 S/N 3

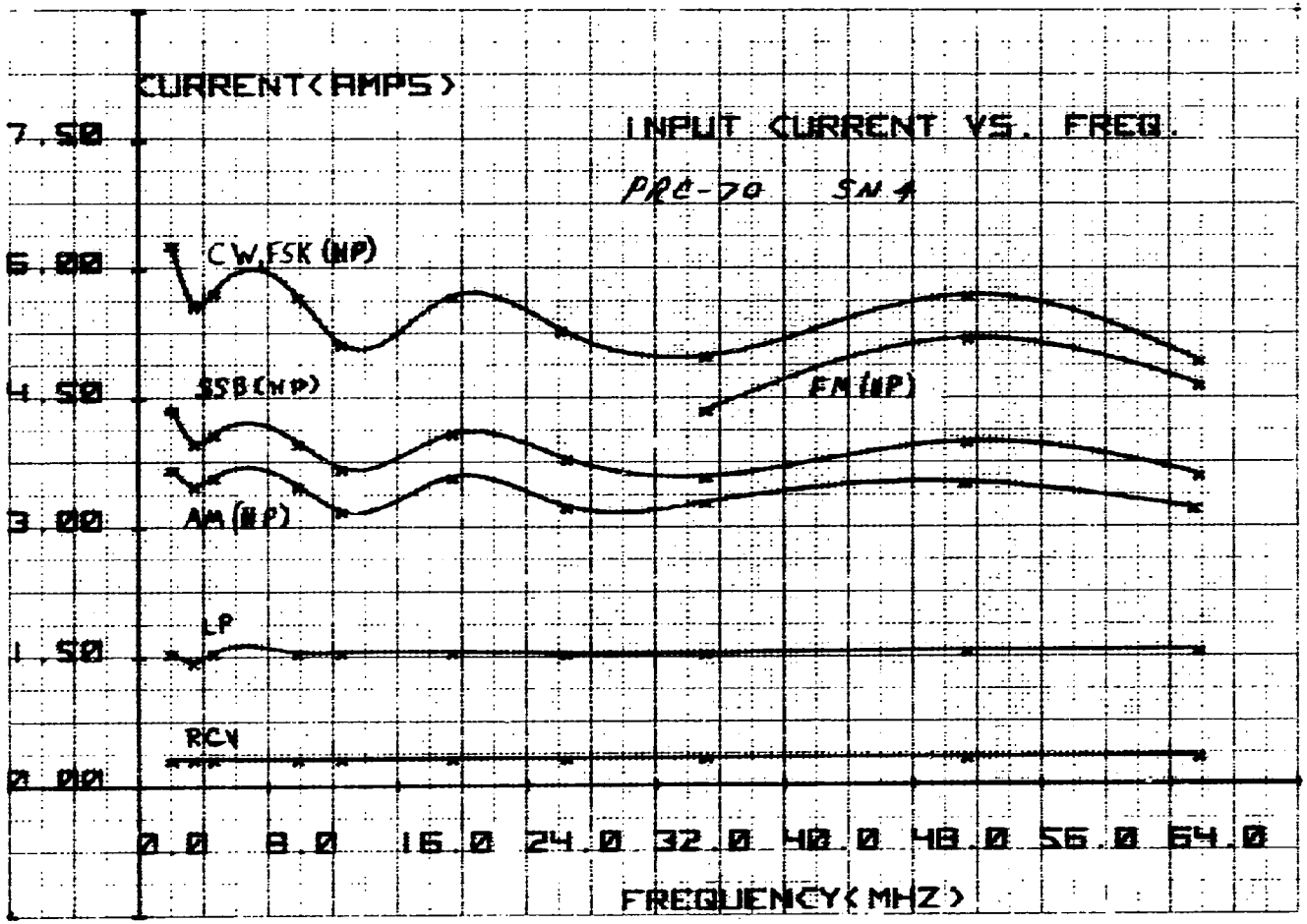


Figure 4. Input Current vs. Frequency – PRC-70 S/N 4

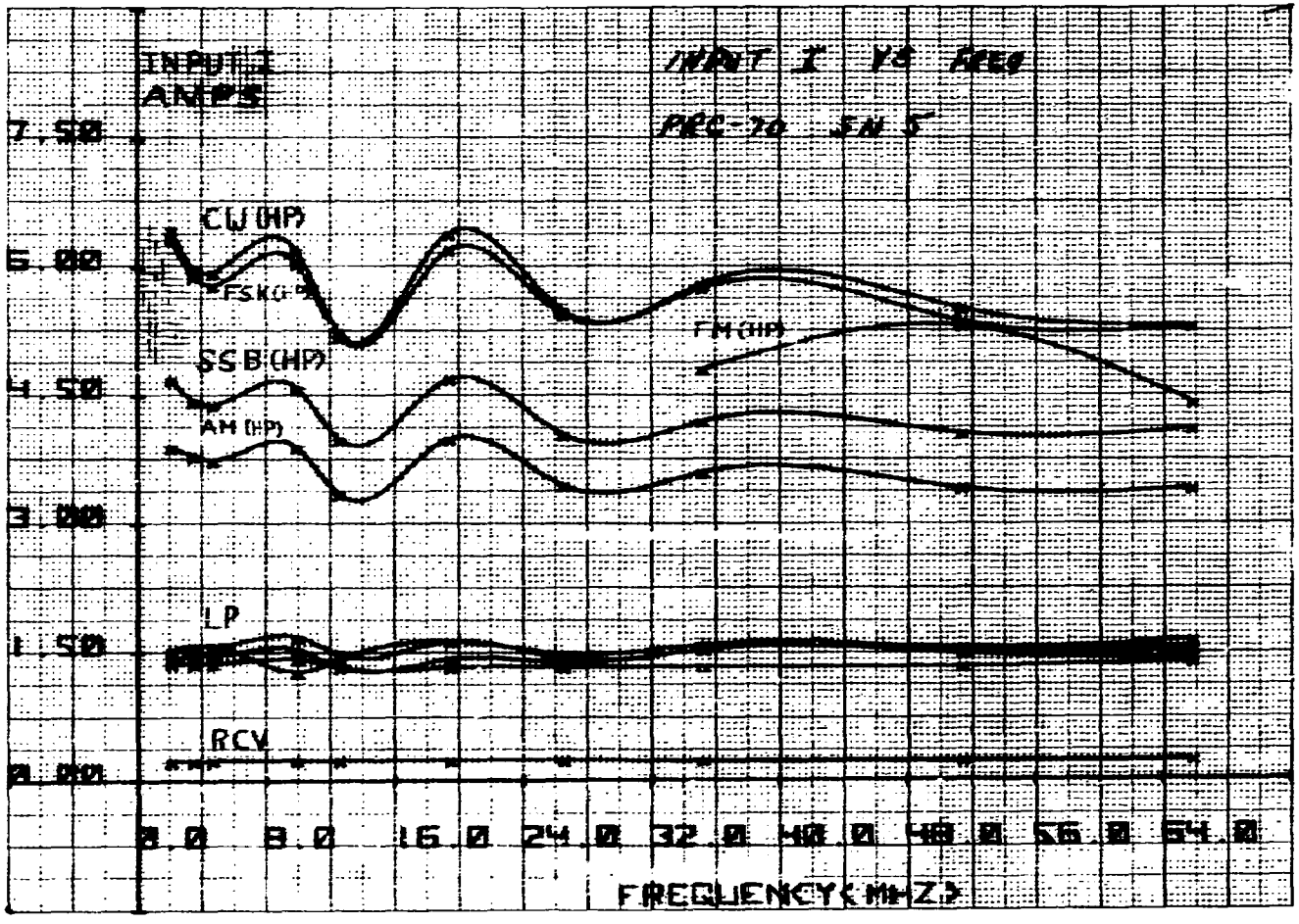


Figure 5. Input Current vs. Frequency – PRC-70 S/N 5

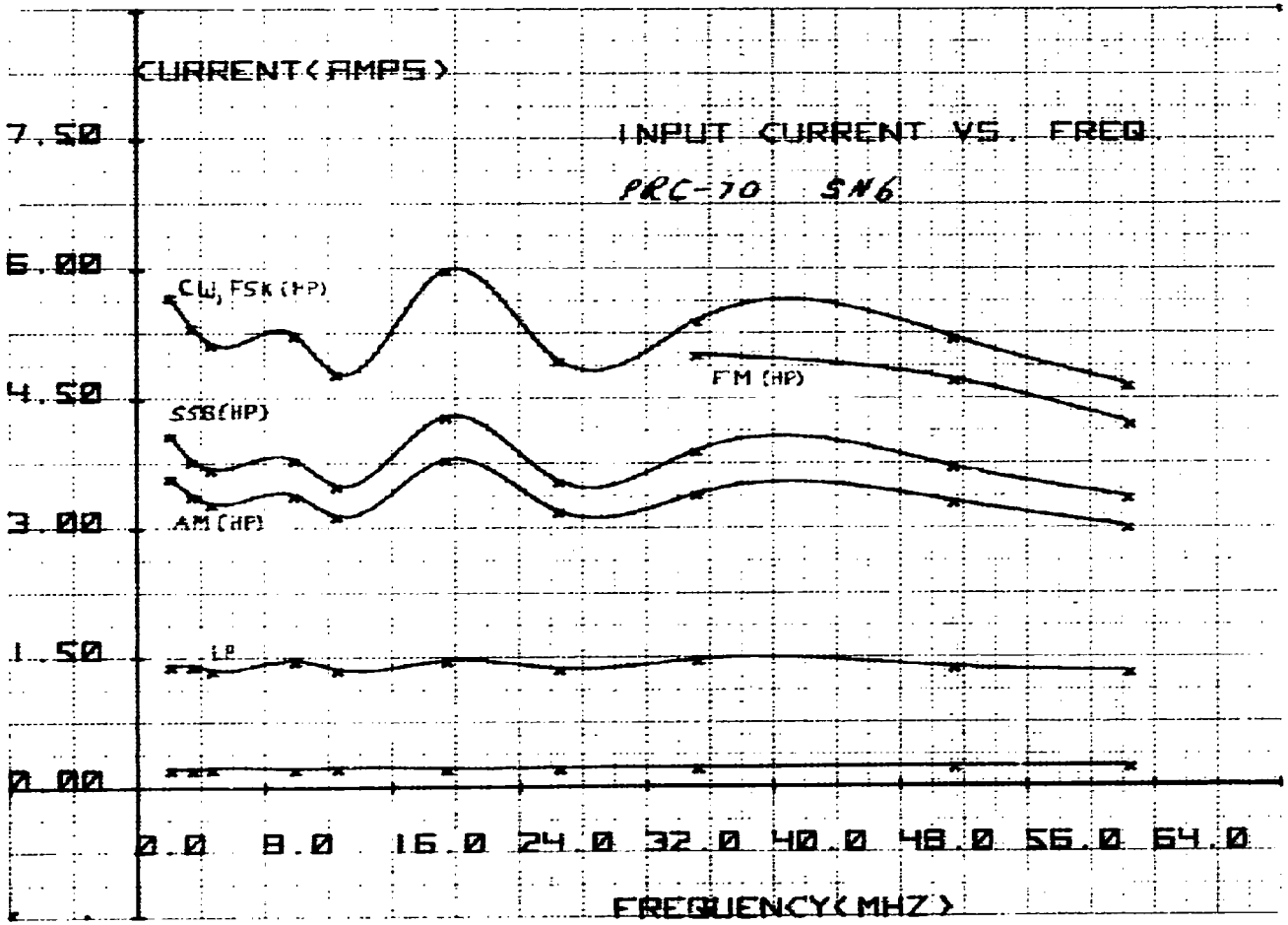


Figure 6. Input Current vs. Frequency – PRC-70 S/N 6

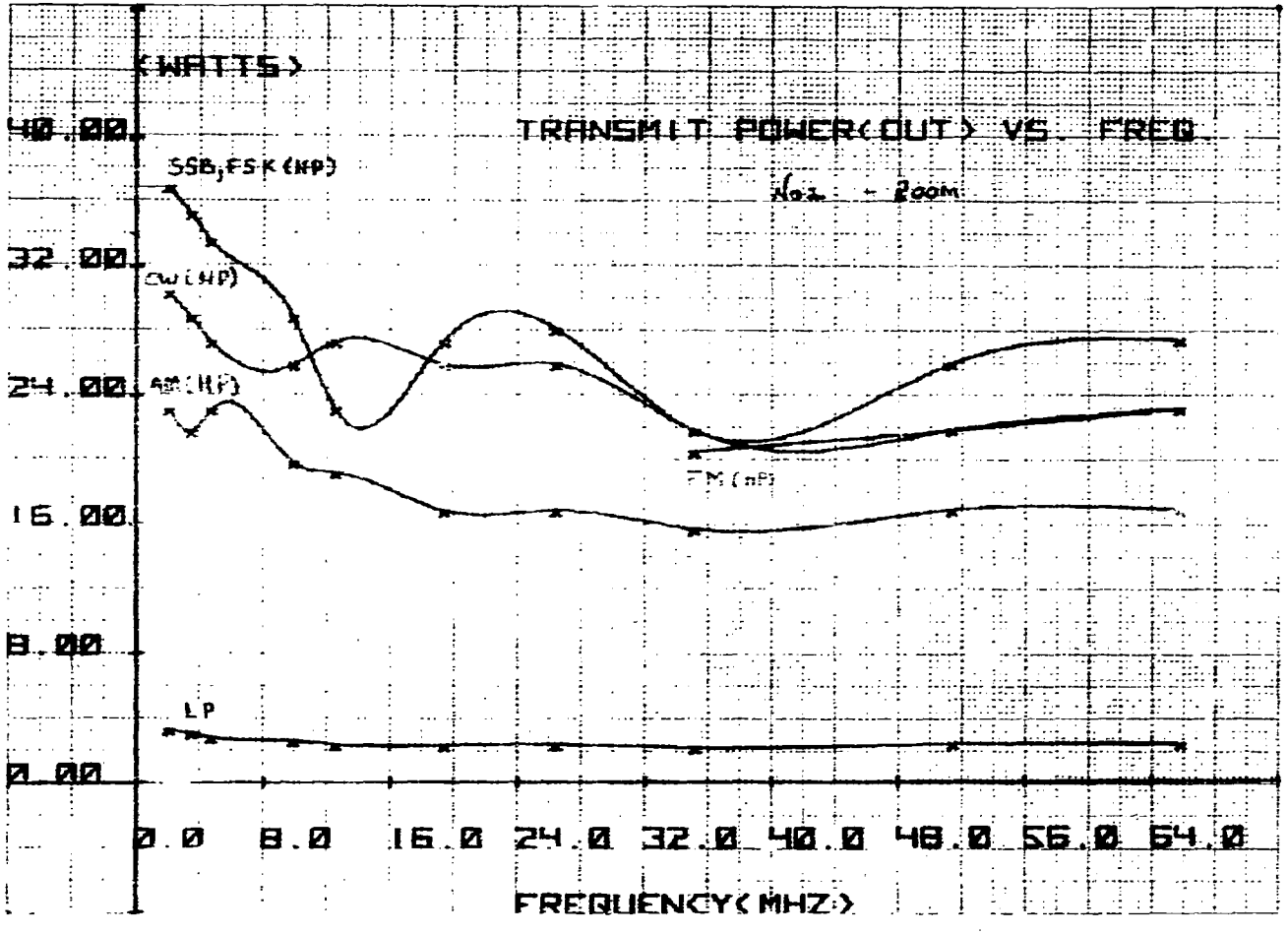
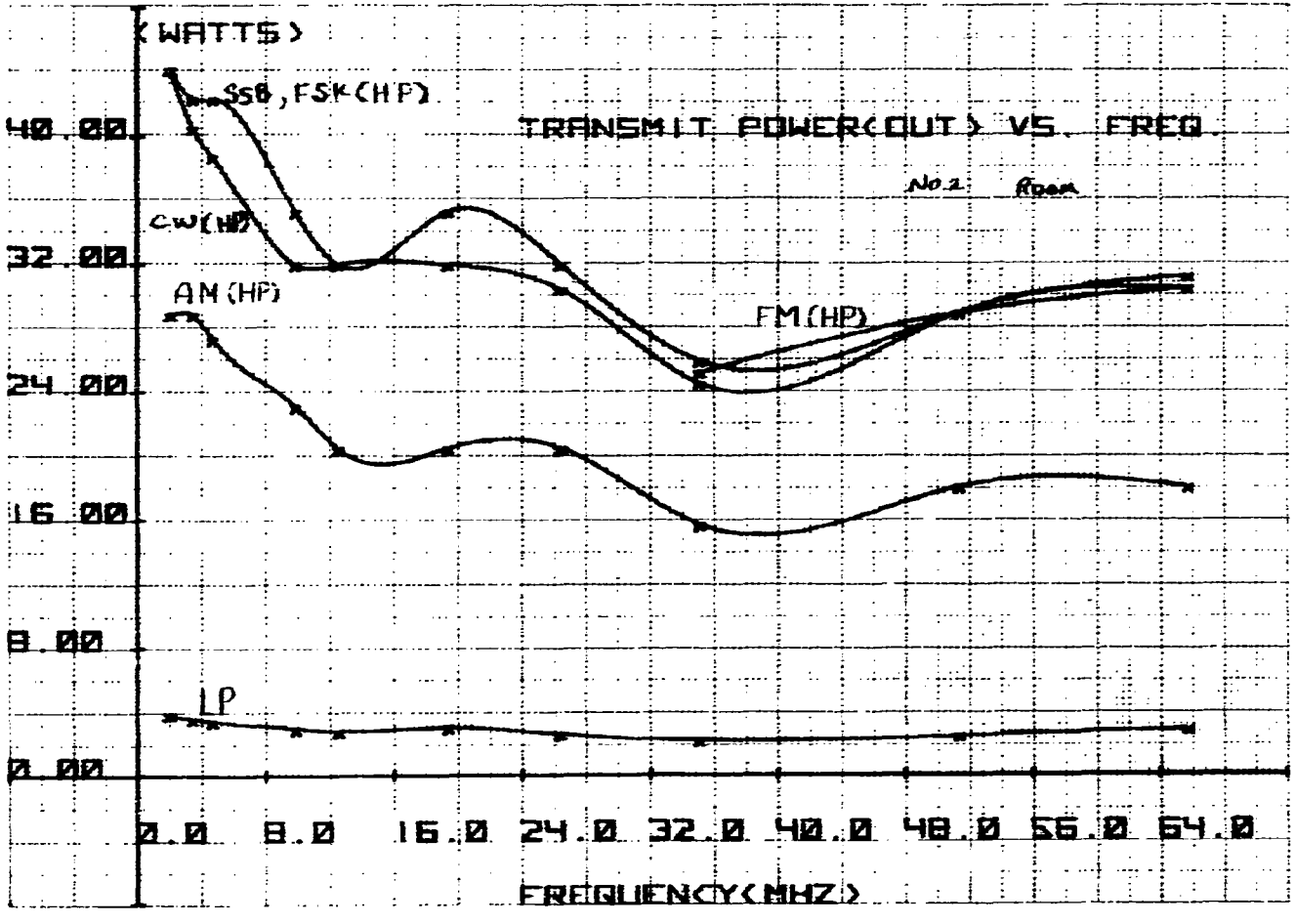


Figure 7. Transmit Power (Out) vs. Frequency S/N 1



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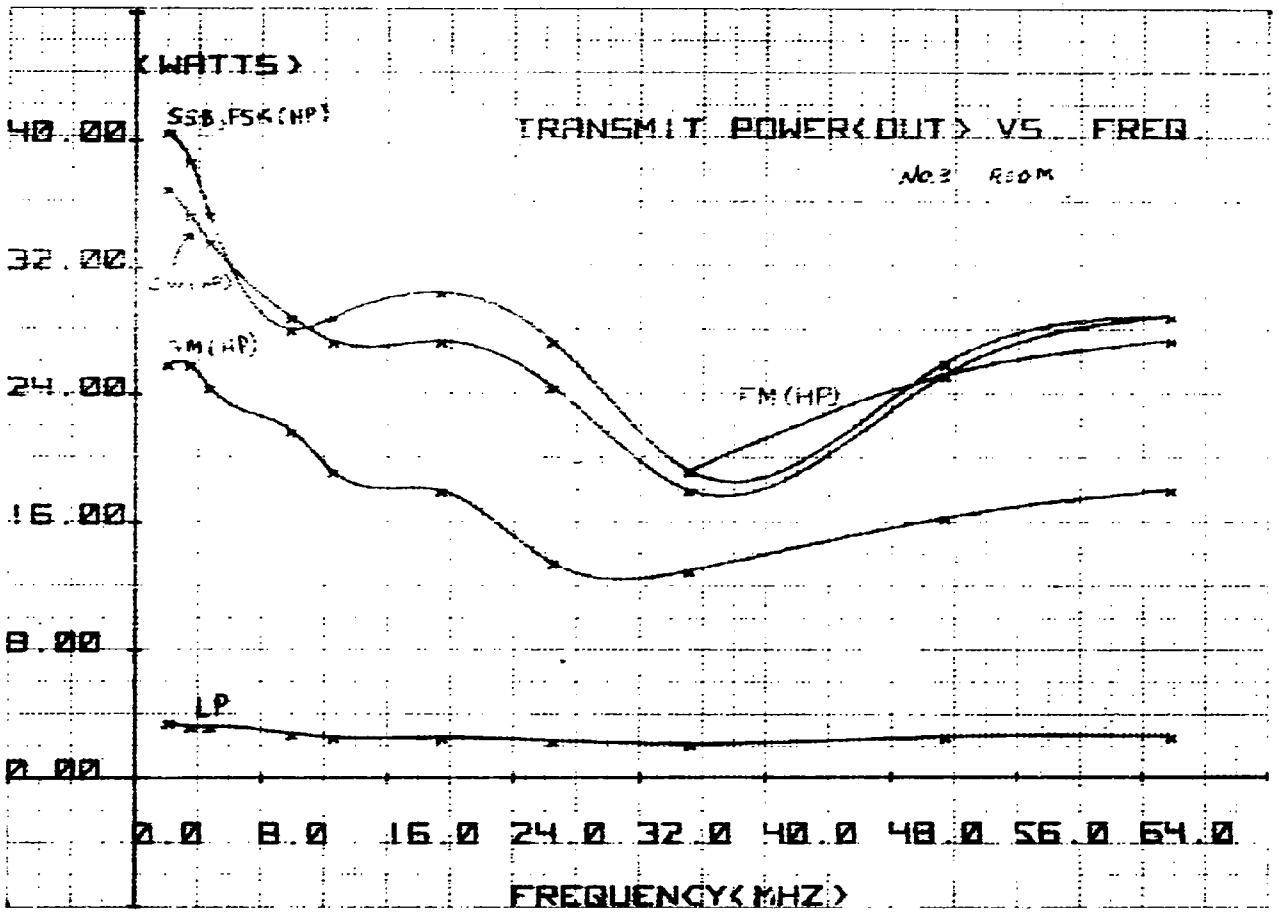

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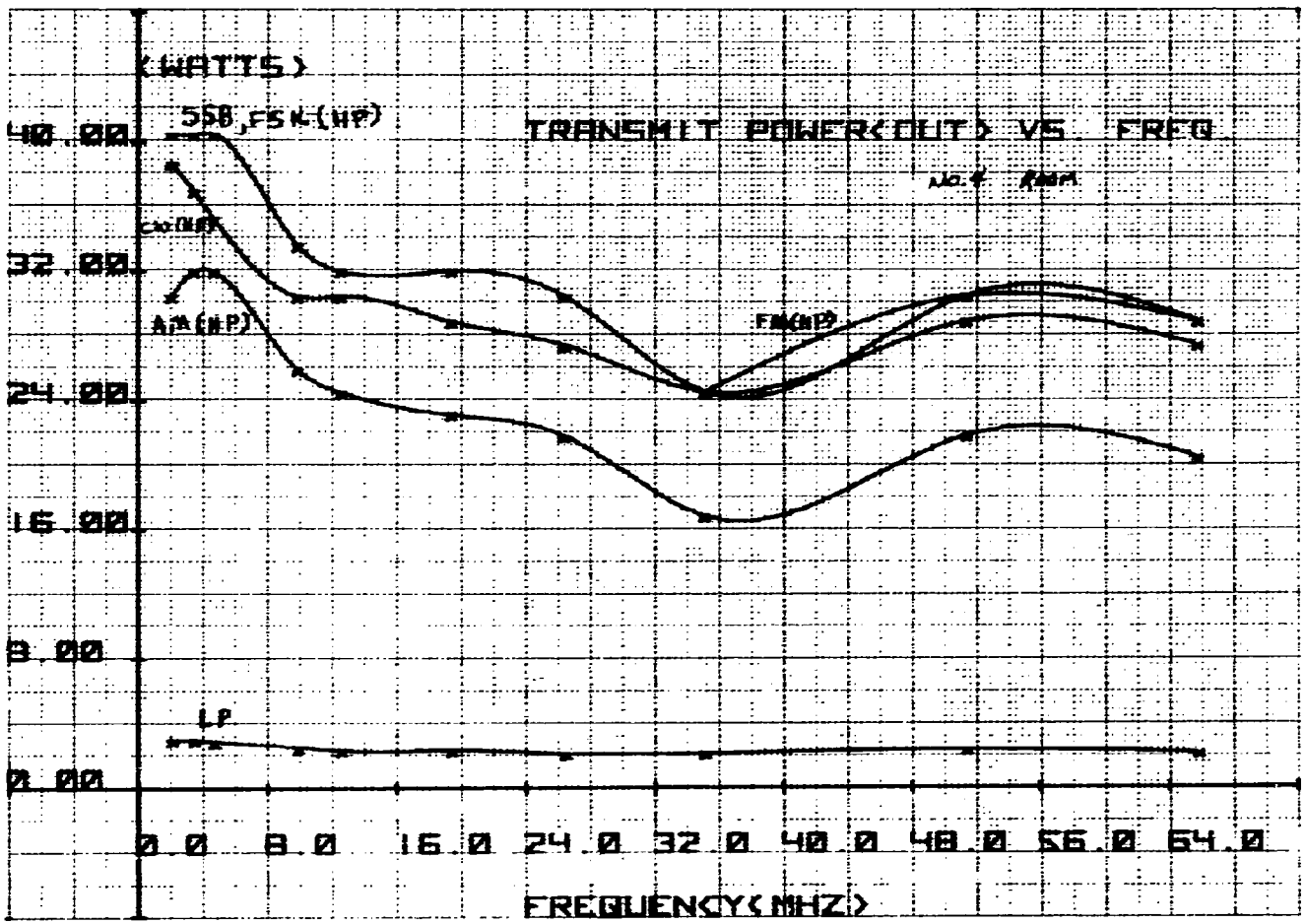

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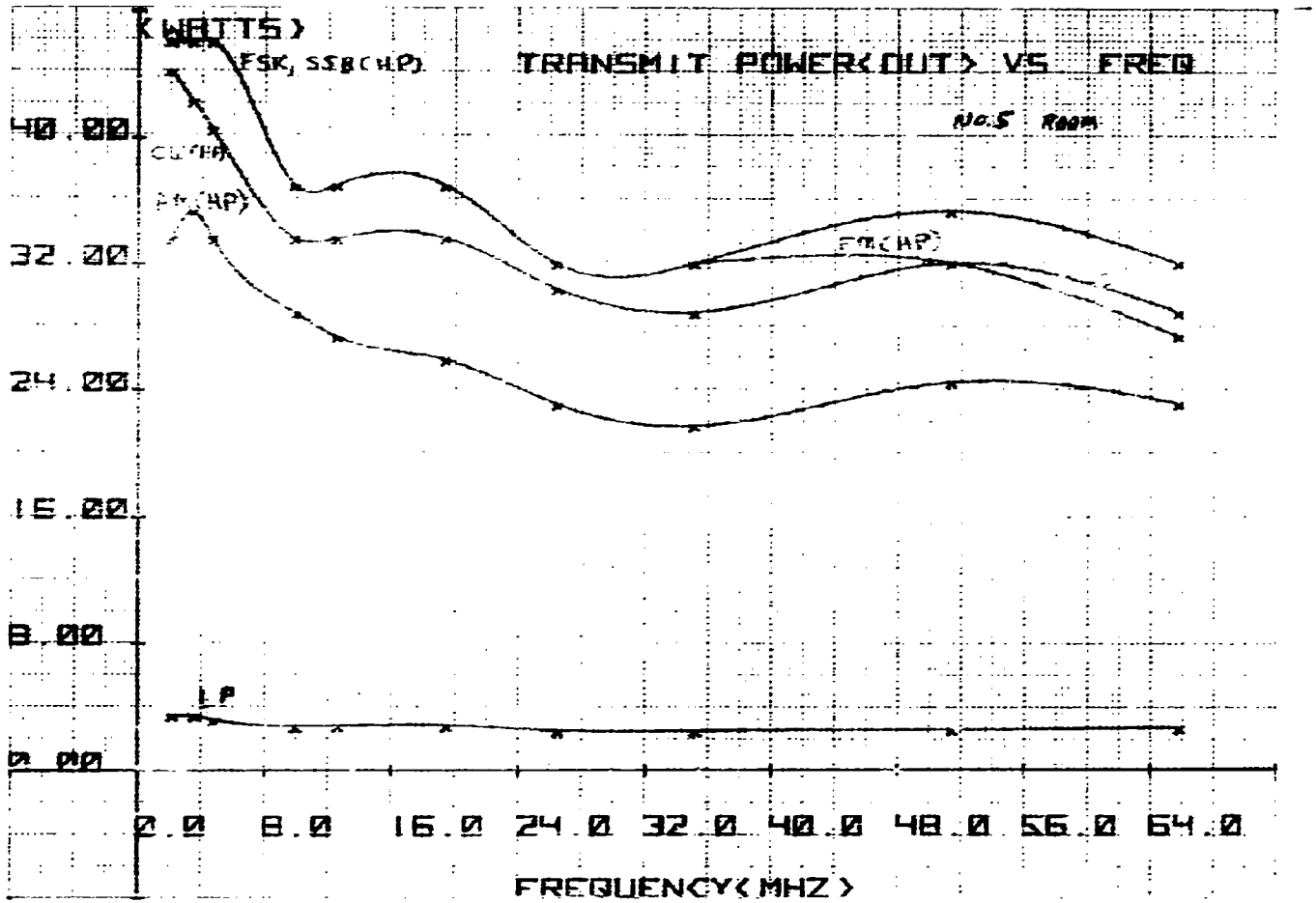

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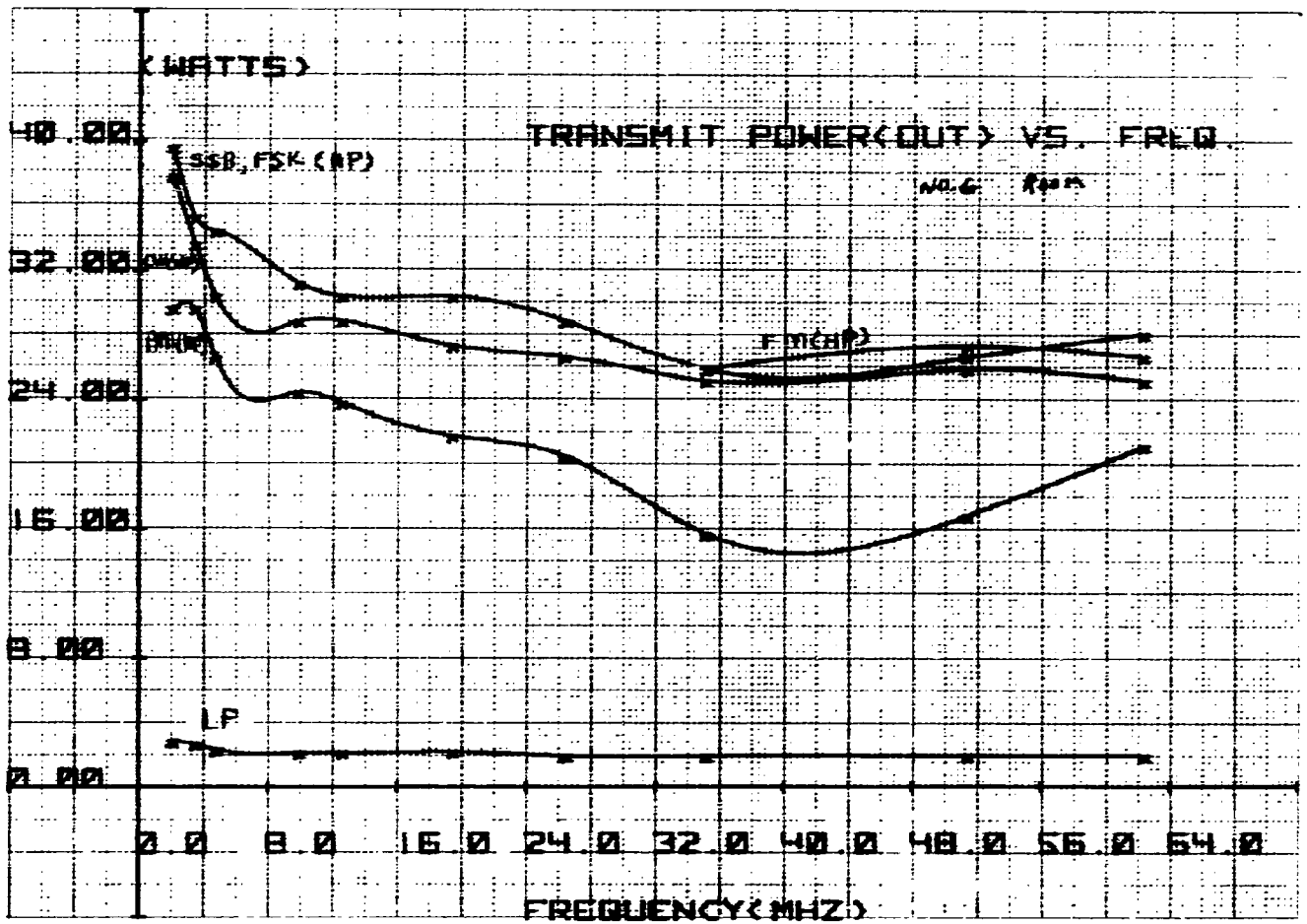


Figure 12. Transmit Power (Out) vs. Frequency S/N 6

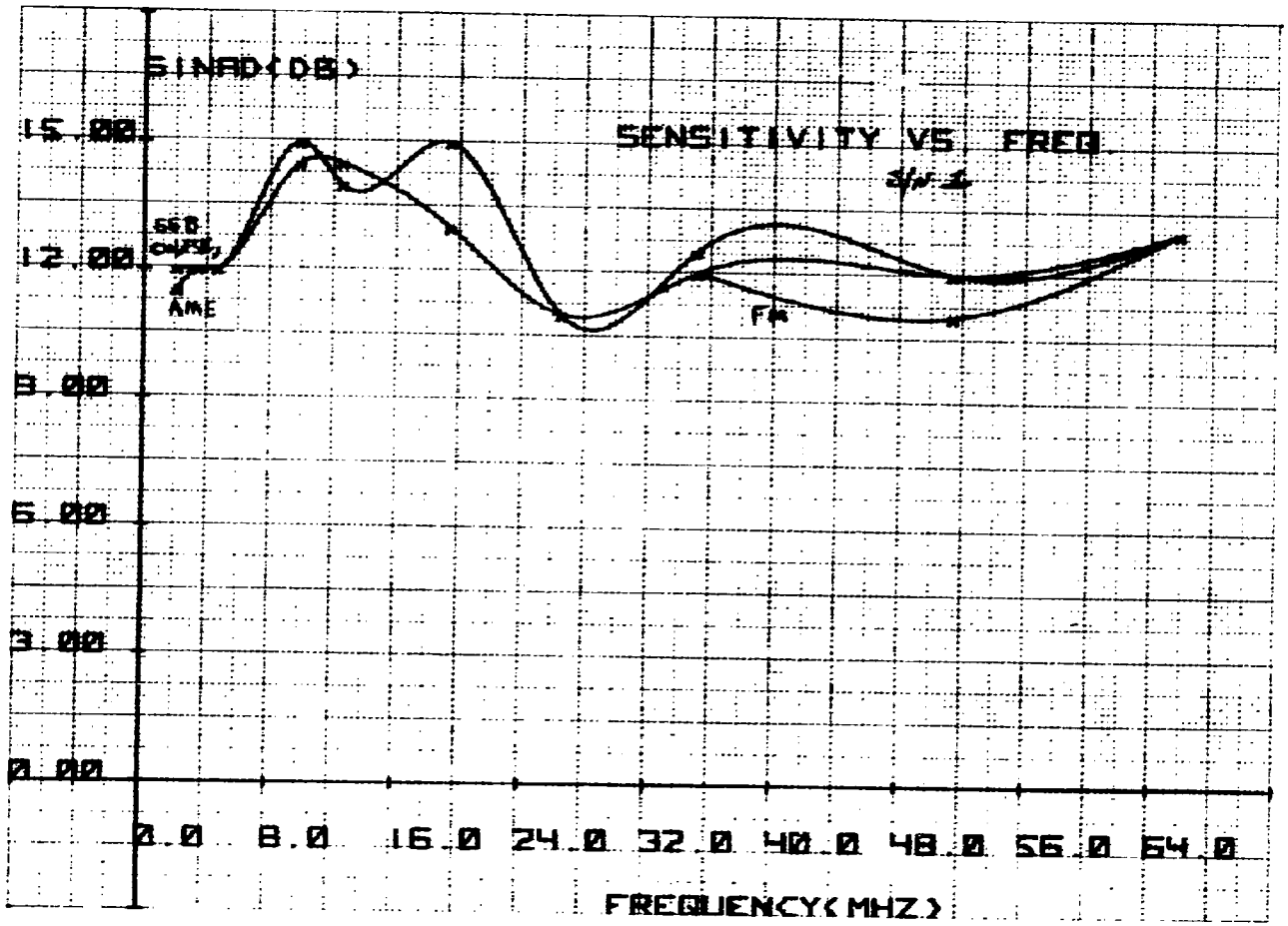


Figure 13. Sensitivity vs. Frequency S/N 1 (SSB, CW, FSK, AME, FM)

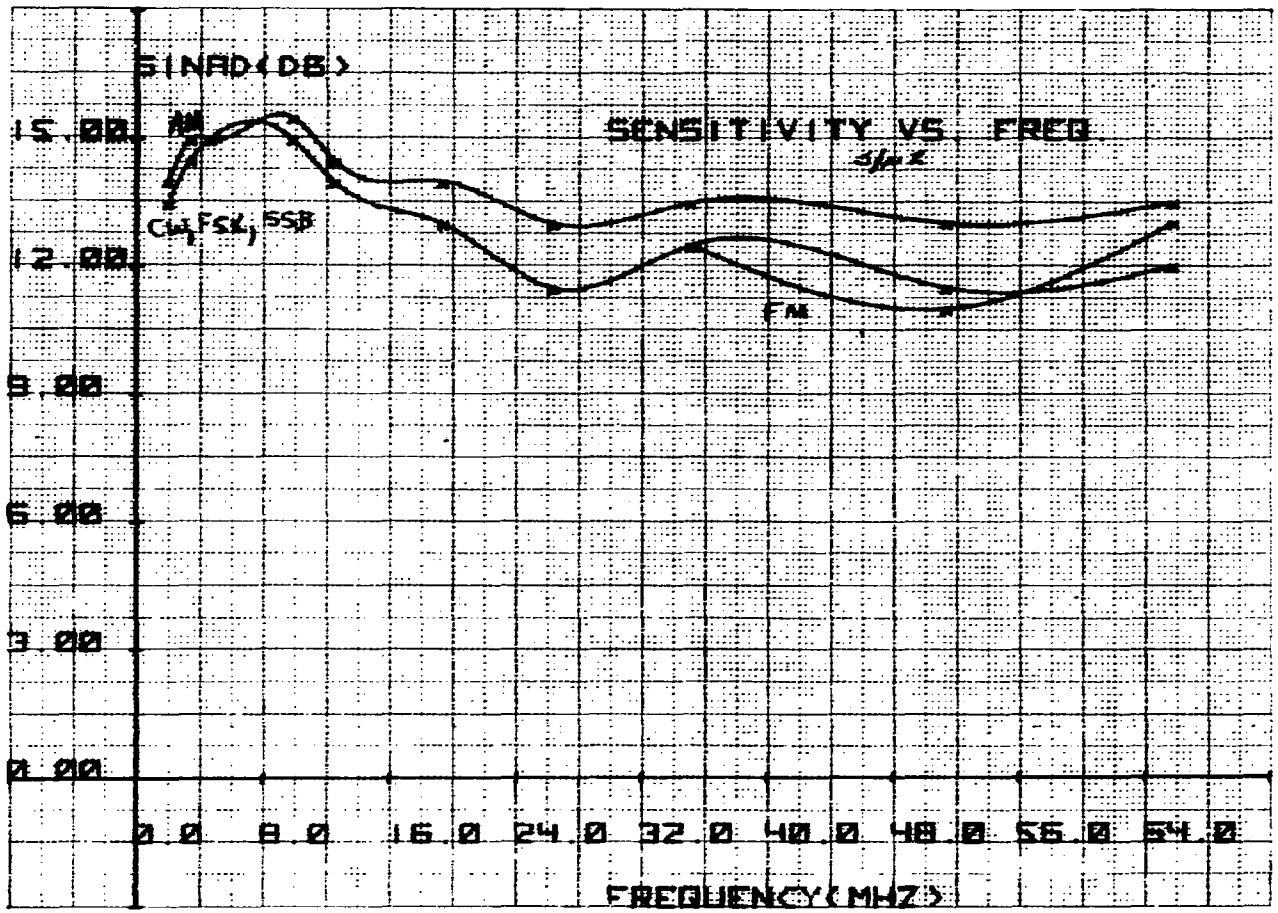


Figure 14. Sensitivity vs. Frequency S/N 2 (SSB, CW, FSK, AME, FM)

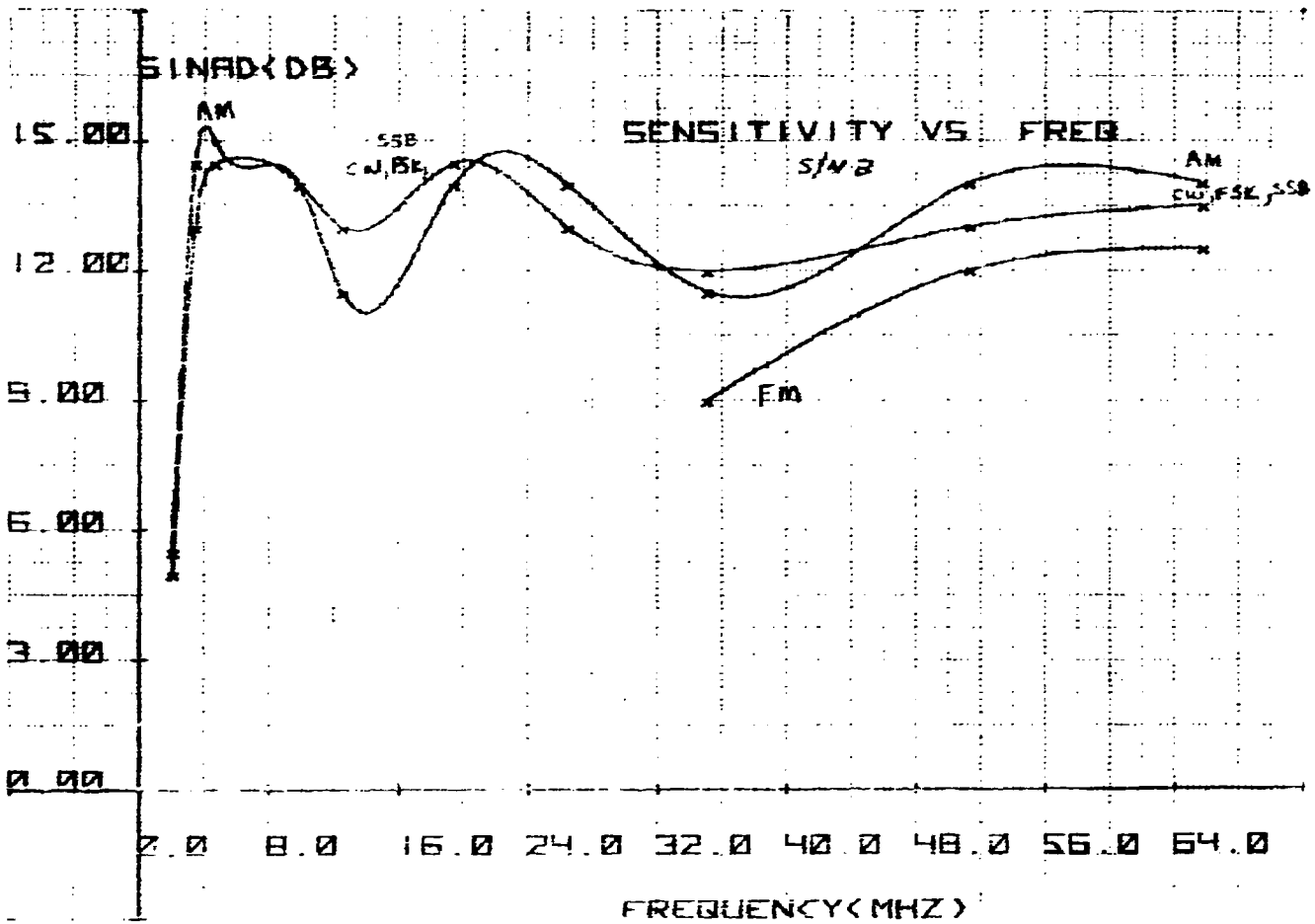
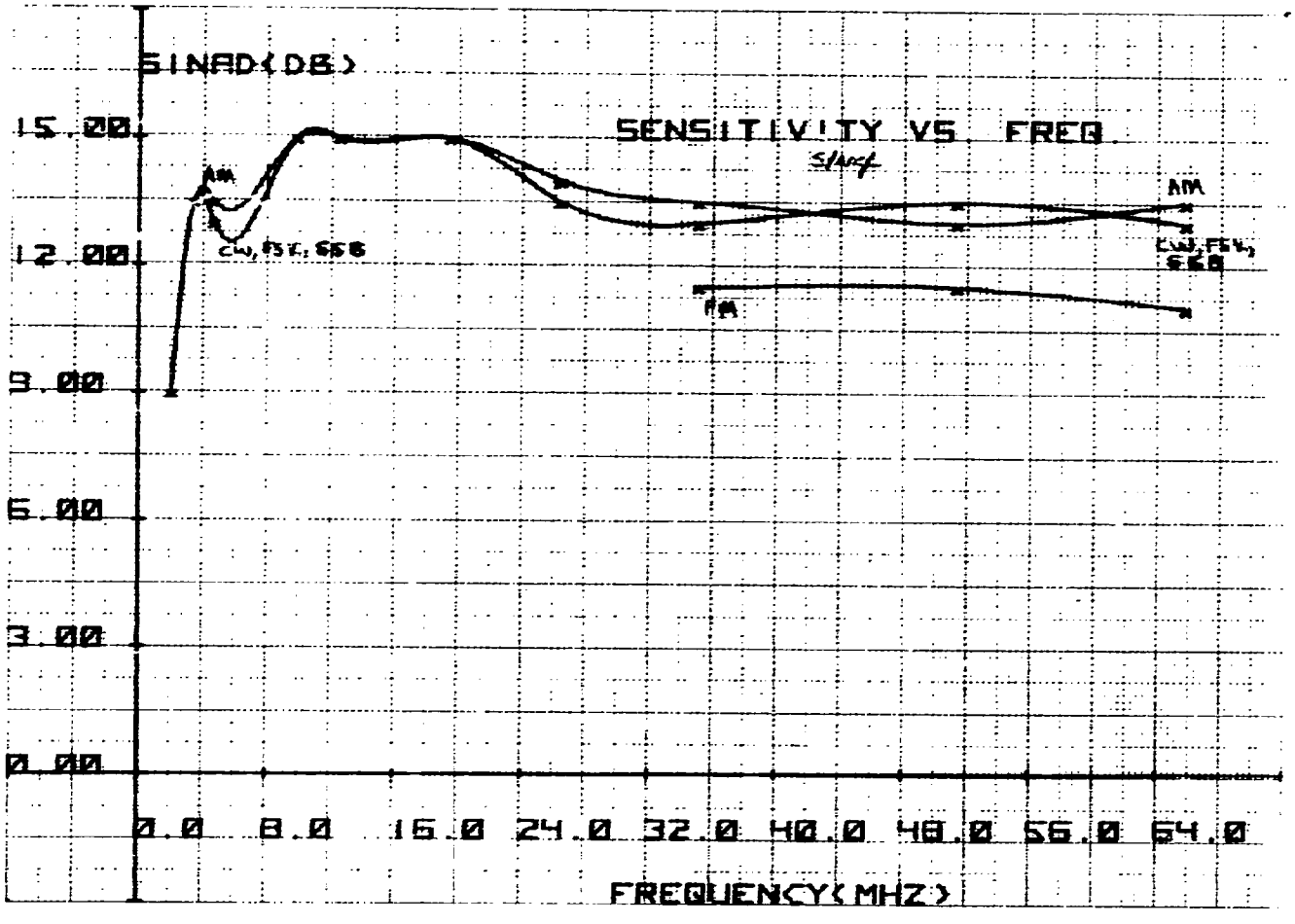


Figure 15. Sensitivity vs. Frequency S/N 3 (SSB, CW, FSK, AME, FM)



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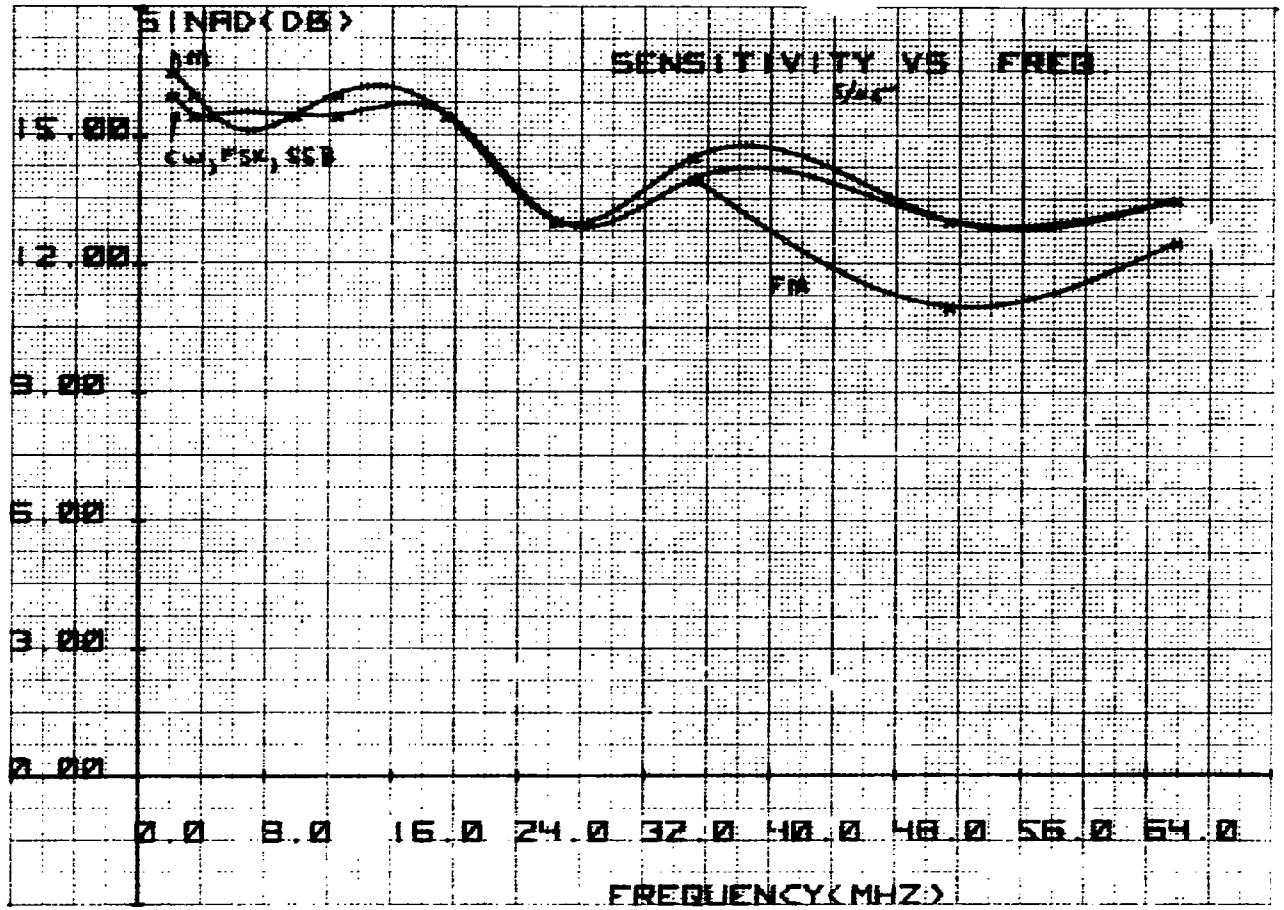

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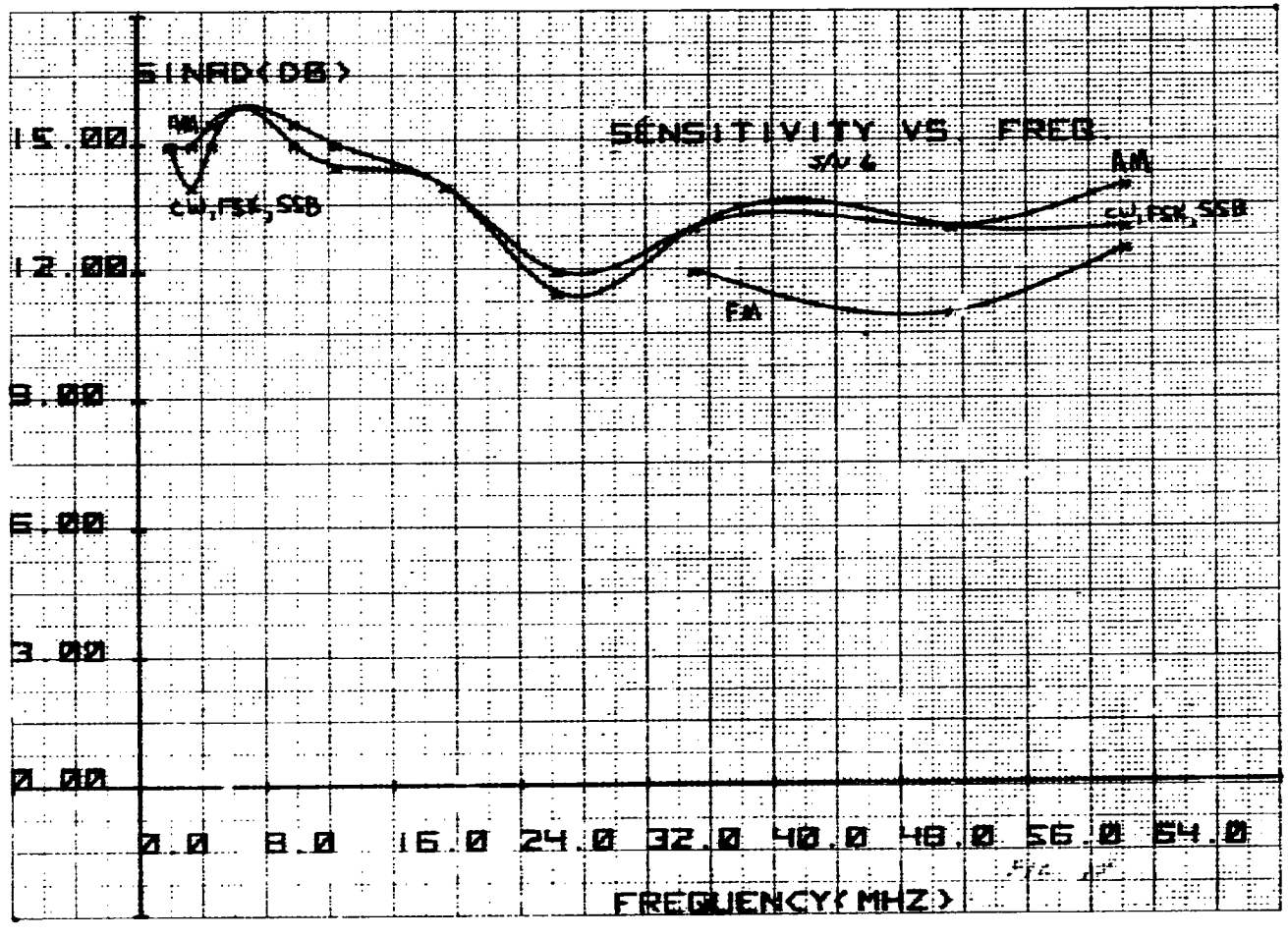

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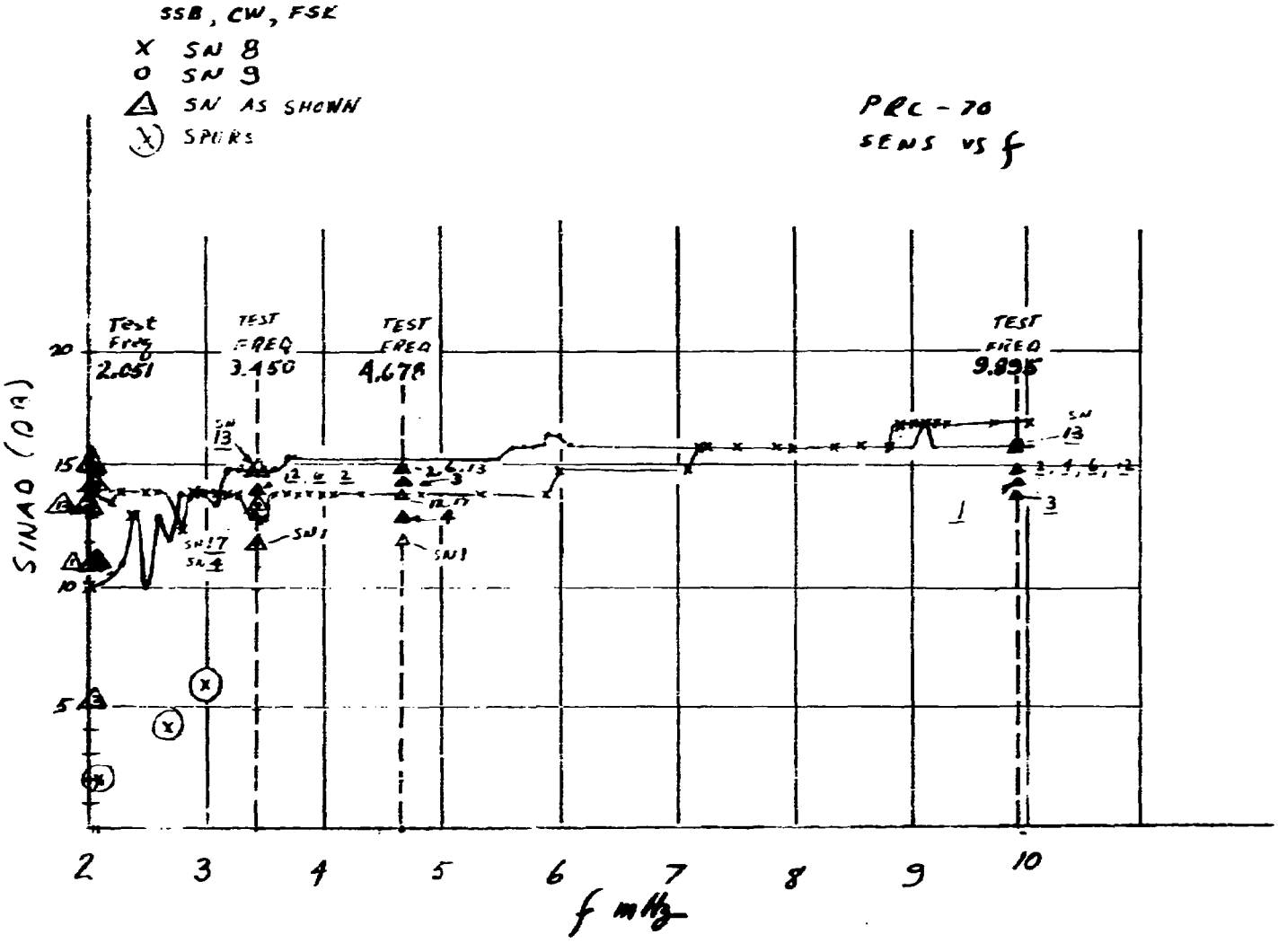

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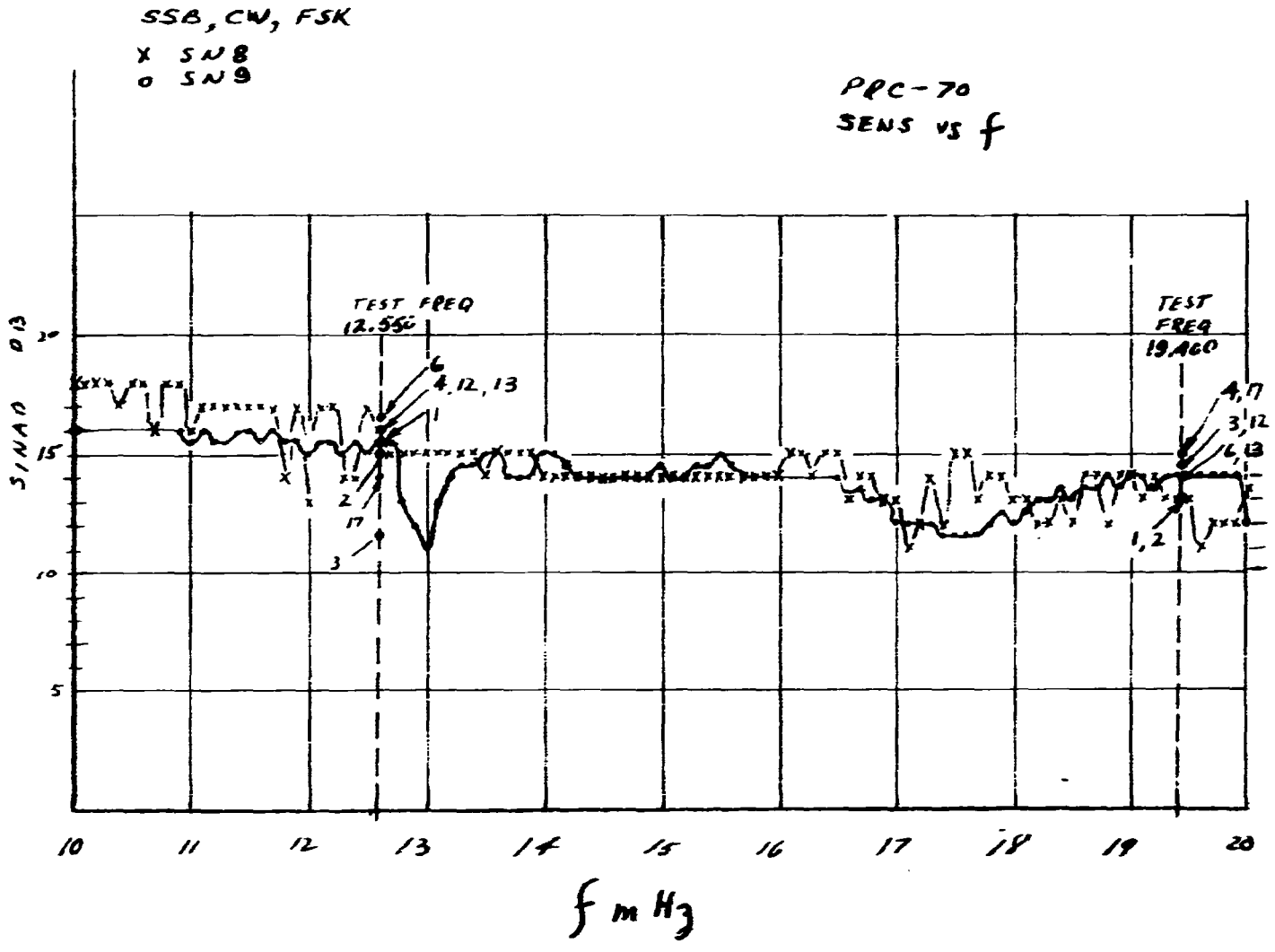

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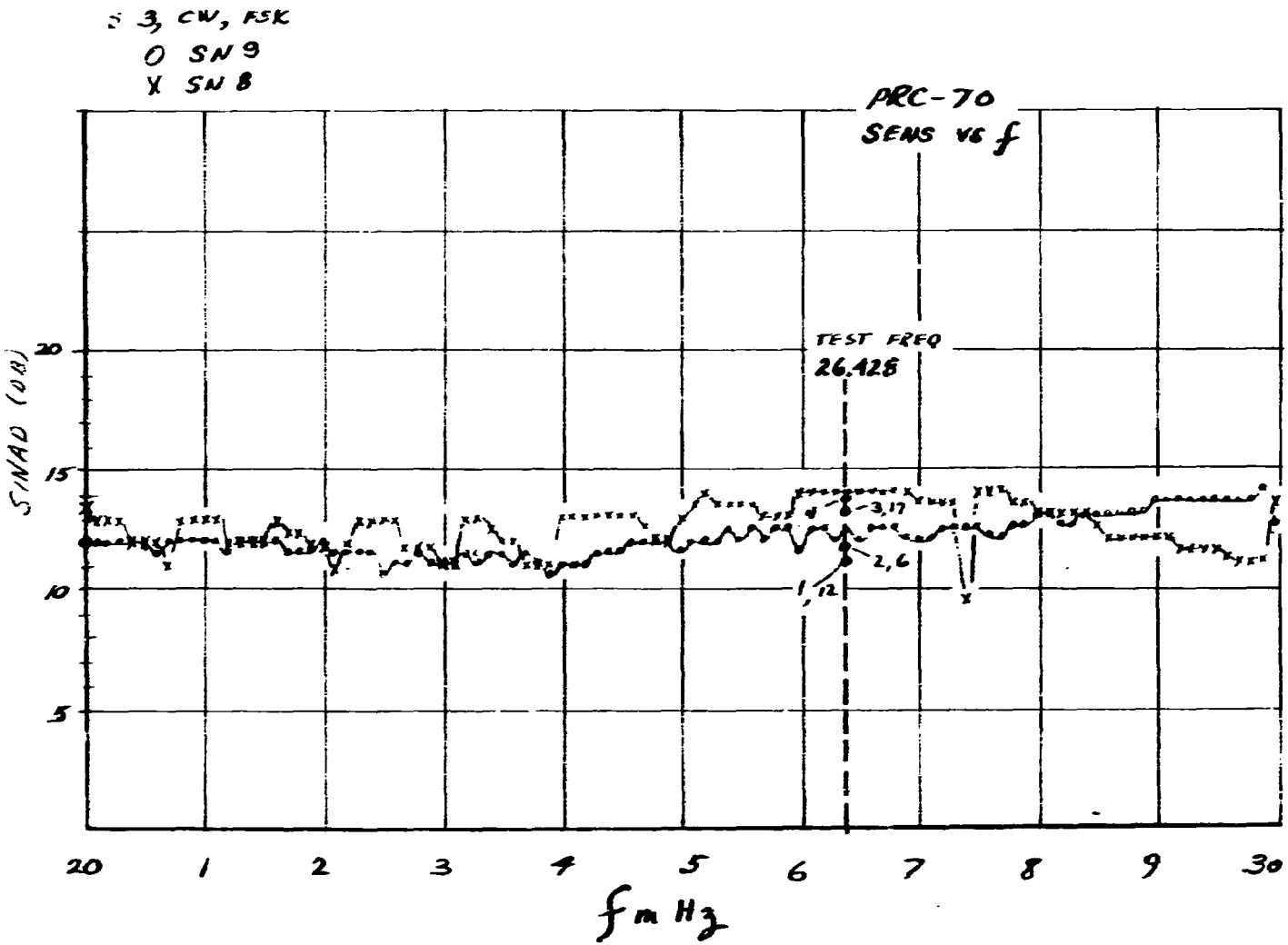

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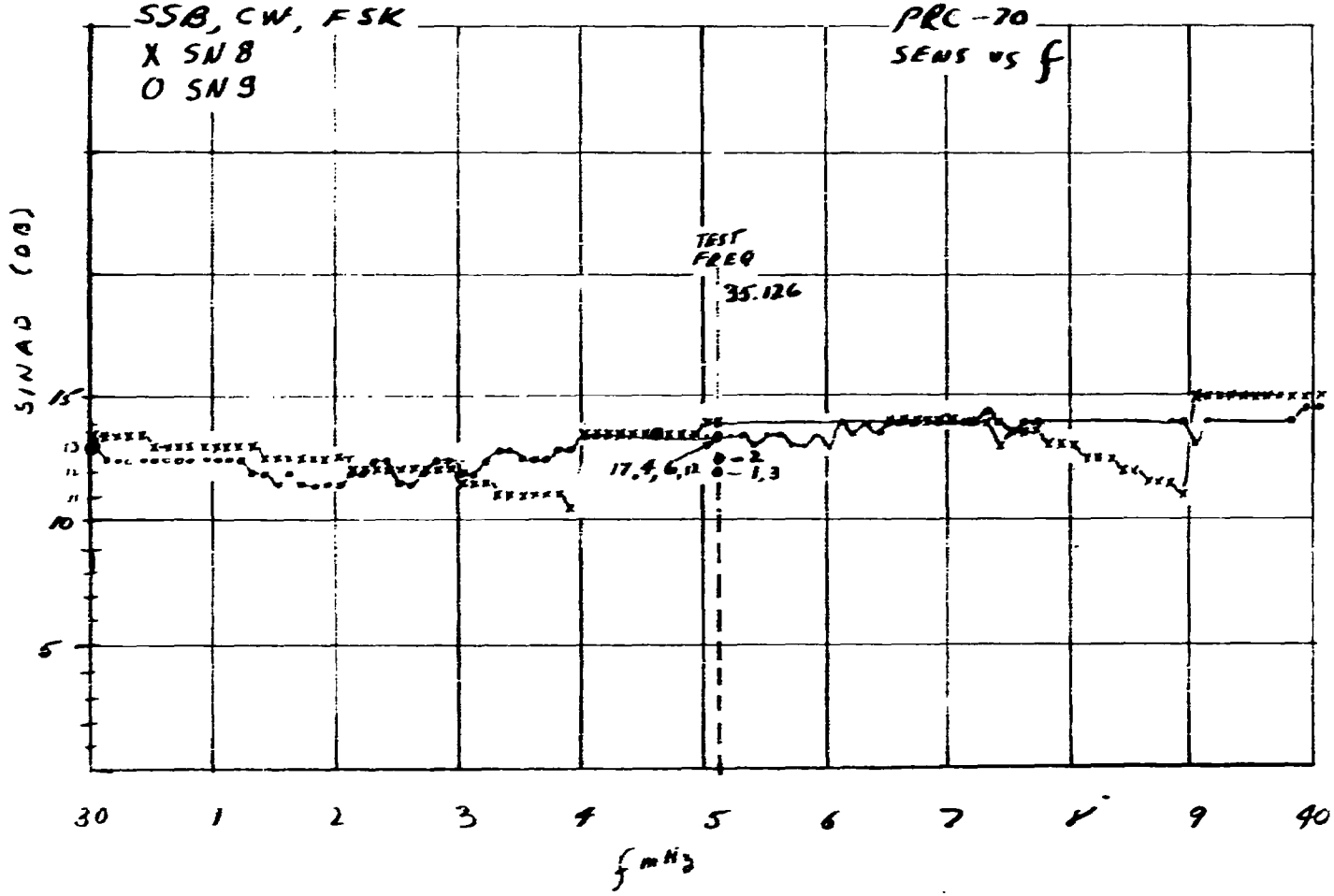
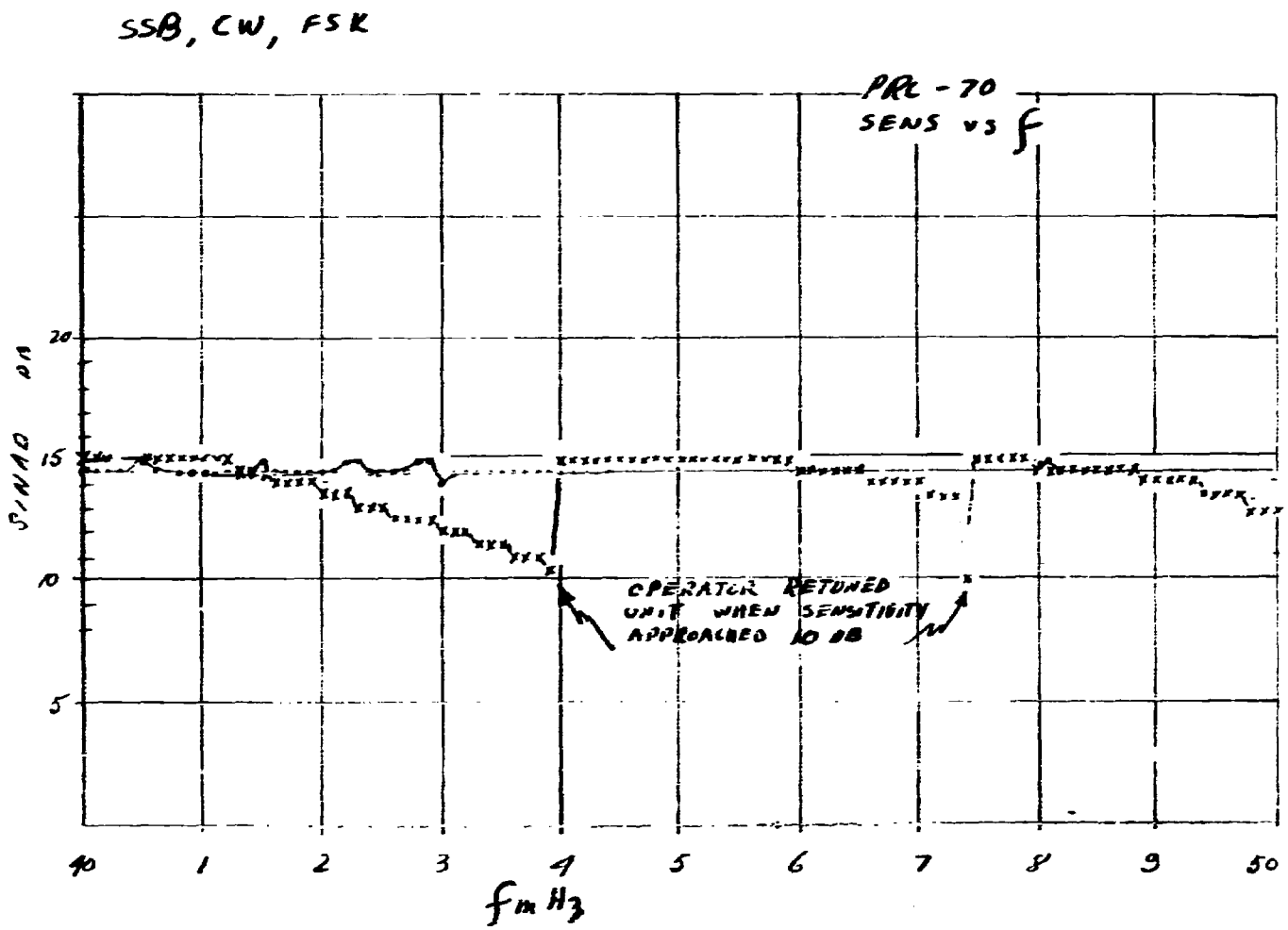


Figure 22. Sensitivity vs. Frequency S/N 8 and 9 (SSB, CW, FSK) 30 to 40 MHz



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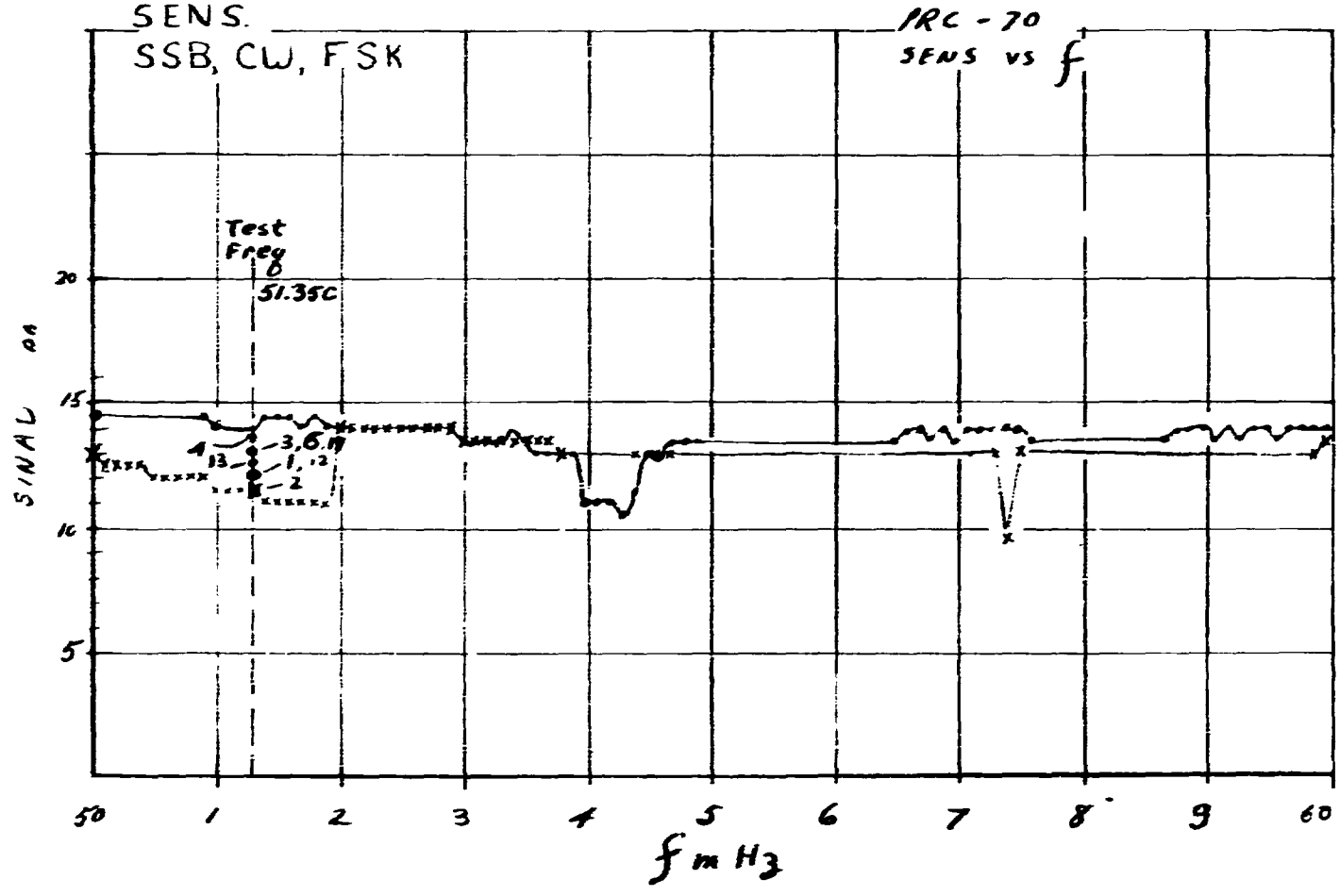

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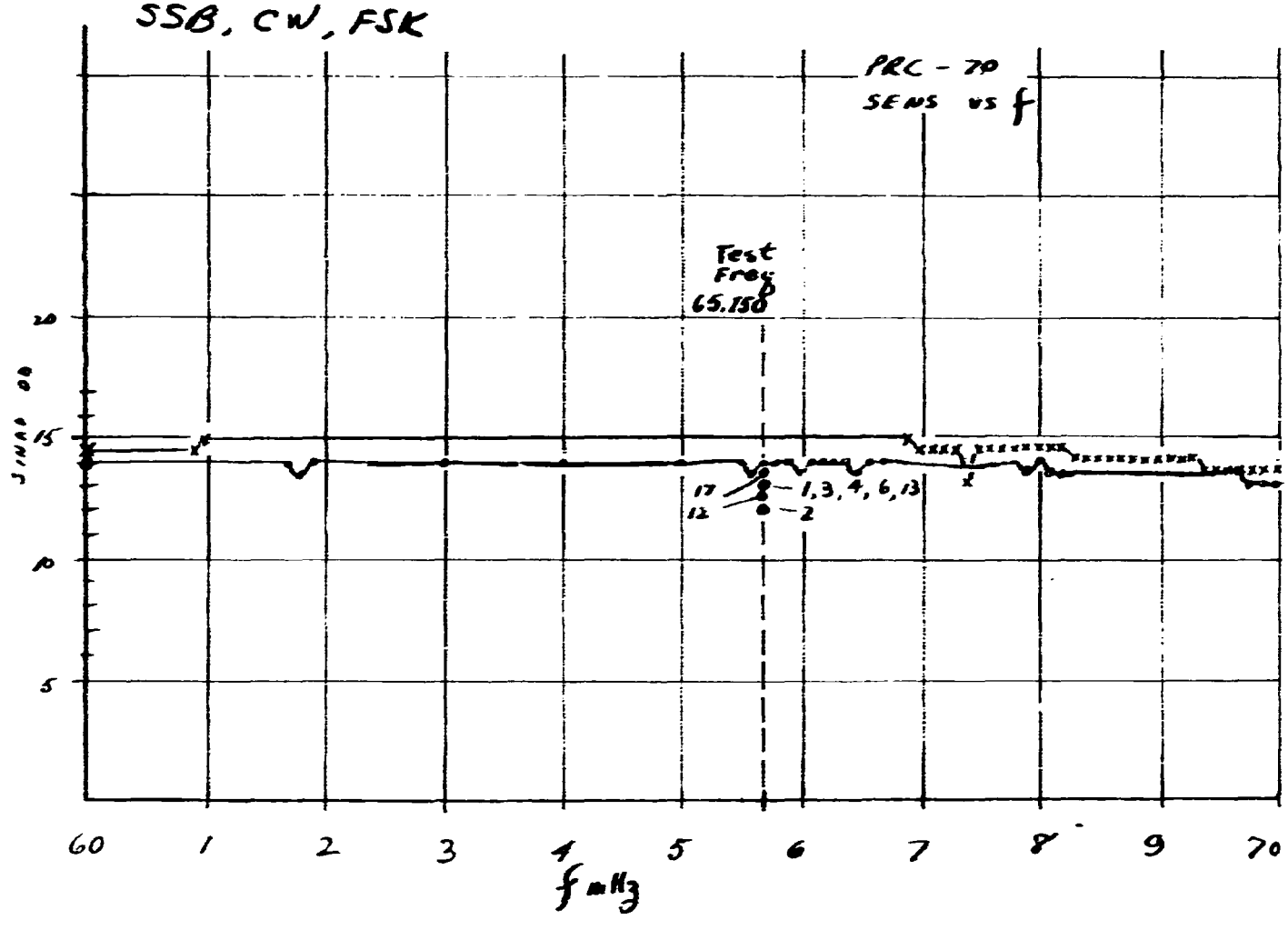

Figure 25. Sensitivity vs. Frequency S/N 8 and 9 (SSB, CW, FSK) 60 to 70 MHz

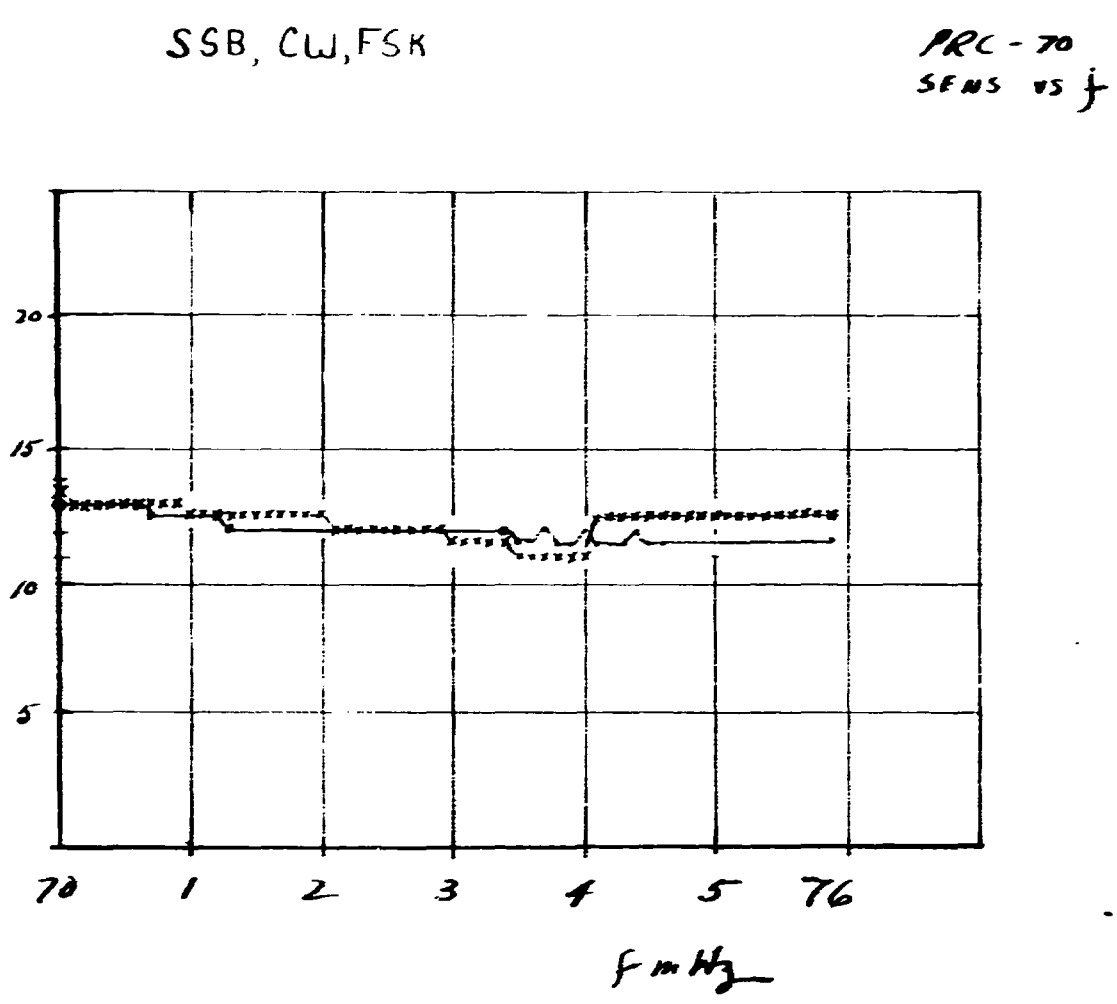

Figure 26. Sensitivity vs. Frequency S/N 8 and 9 (SSB, CW, FSK) 70 to 76 MHz

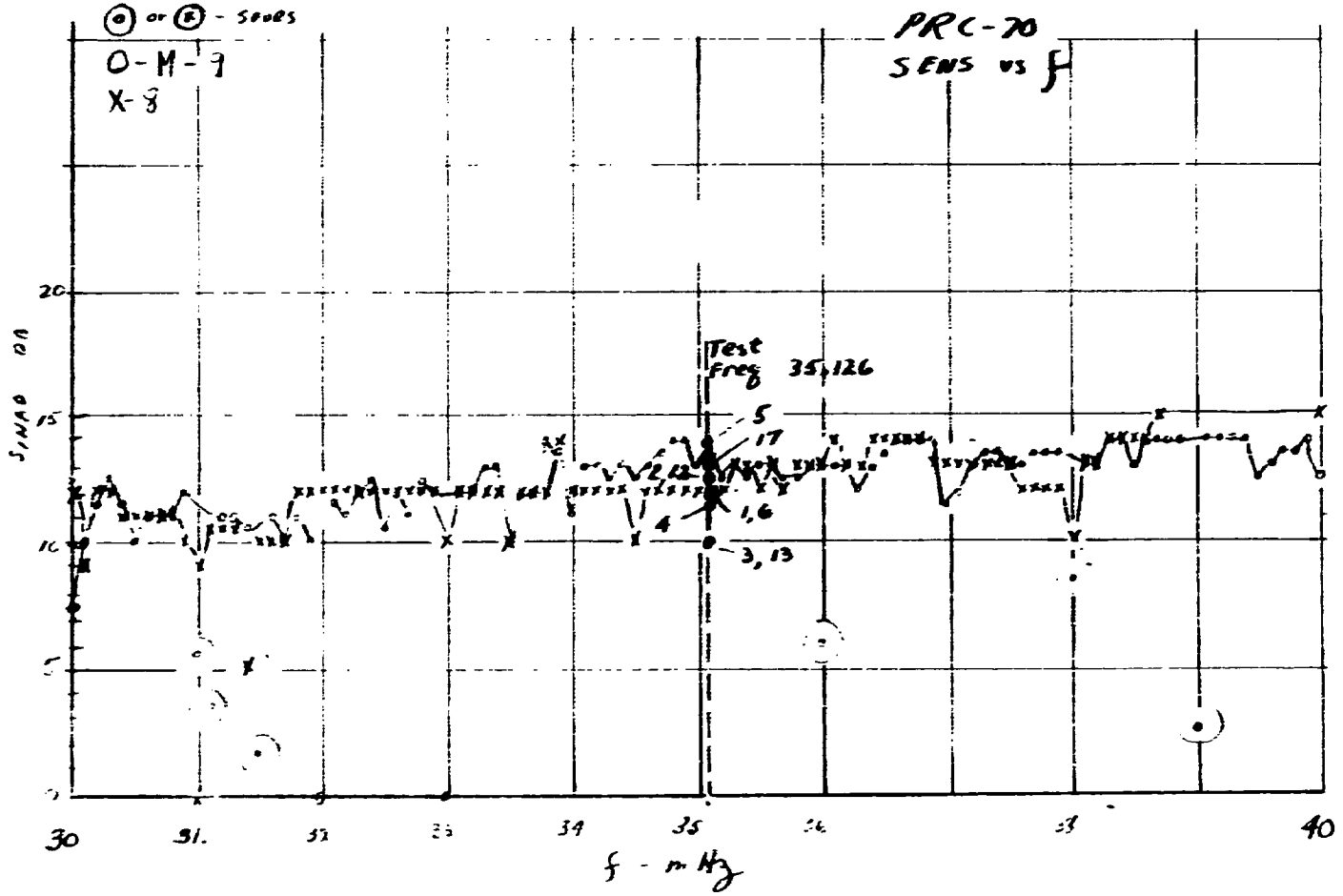

Figure 27. Sensitivity vs. Frequency S/N 8 and 9 (FM) 30 to 40 MHz

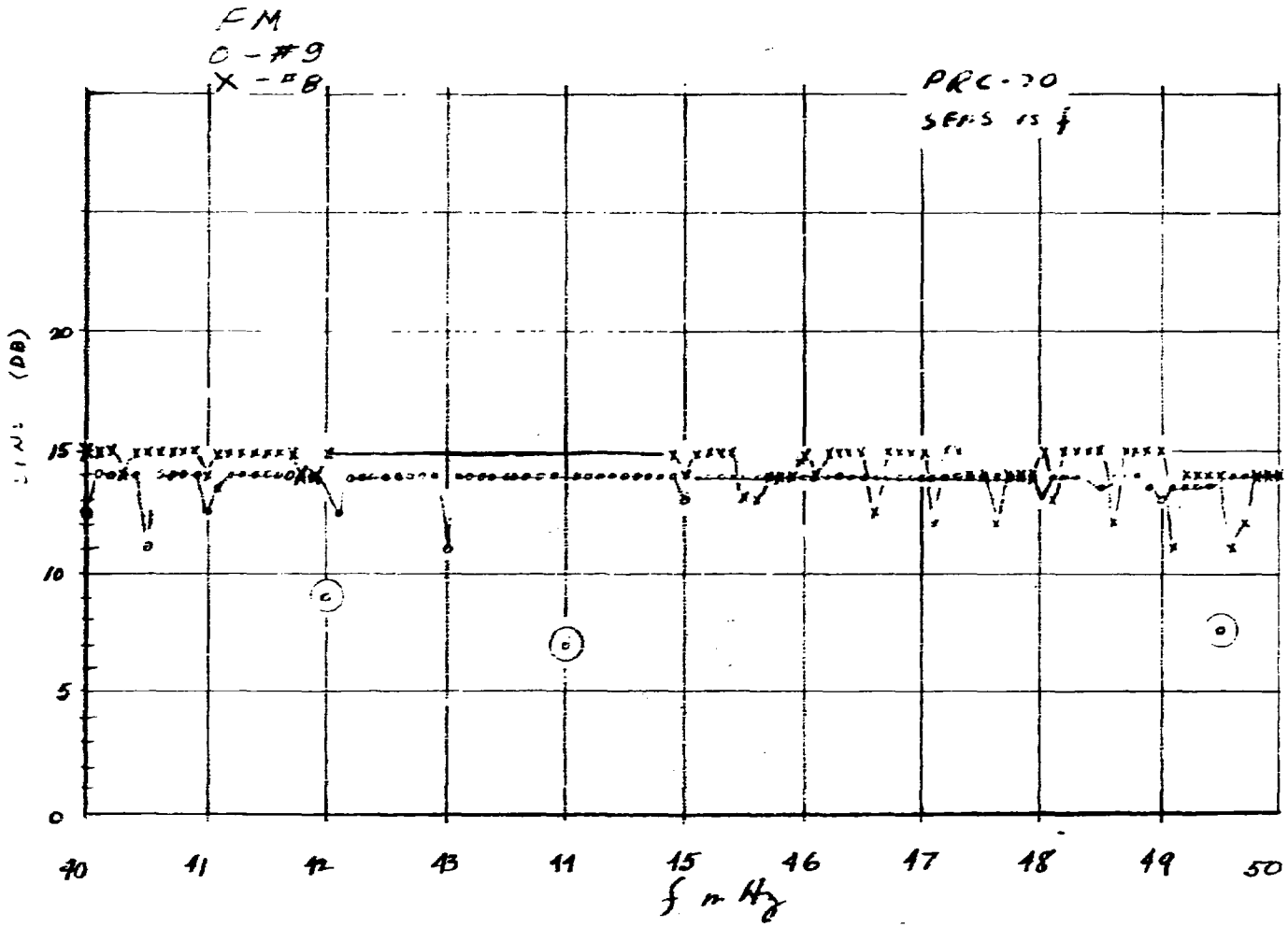

Figure 28. Sensitivity vs. Frequency S/N 8 and 9 (FM) 40 to 50 MHz

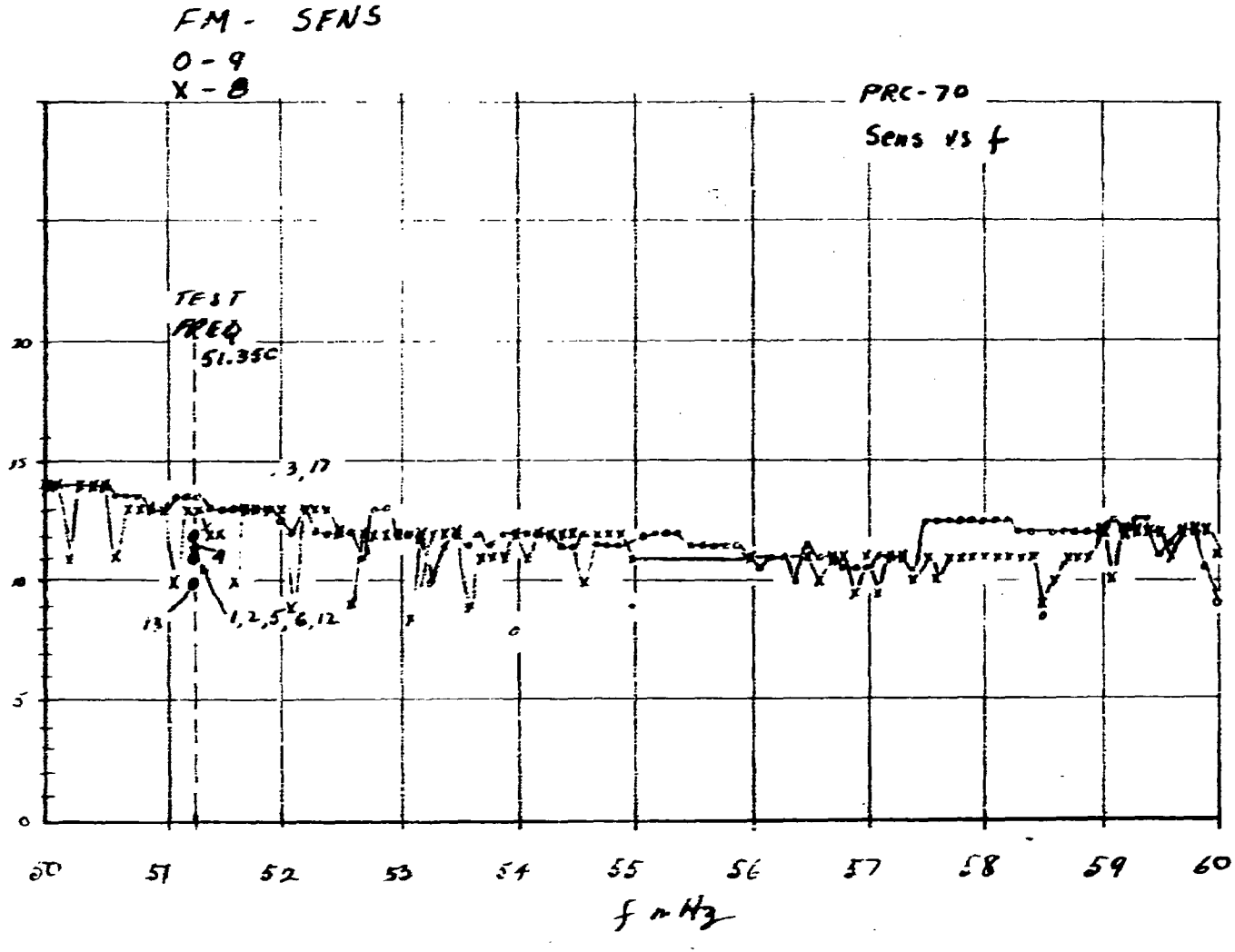

Figure 29. Sensitivity vs. Frequency S/N 8 and 9 (FM) 50 to 60 MHz

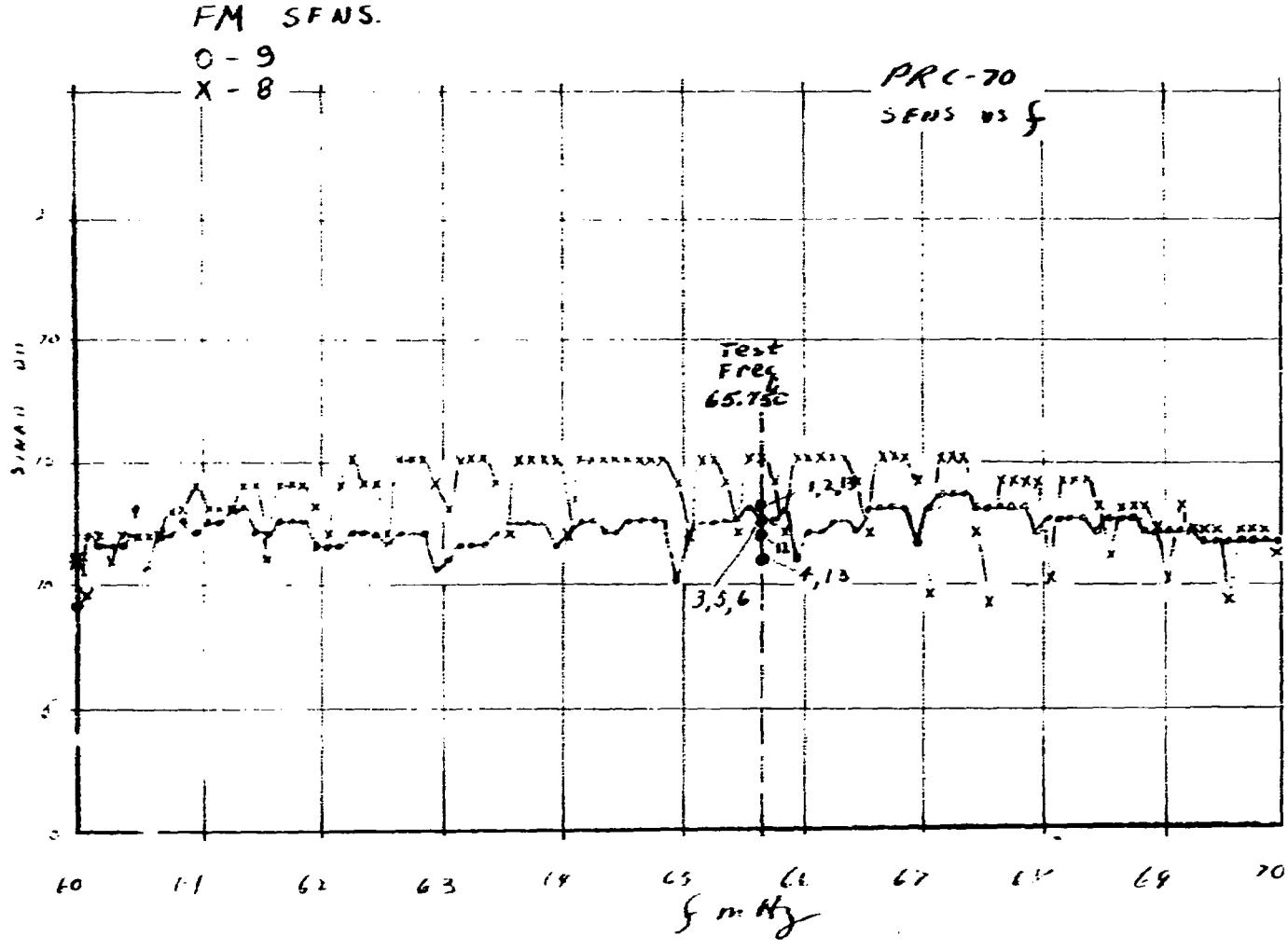

Figure 30. Sensitivity vs. Frequency S/N 8 and 9 (FM; 69 to 70 MHz

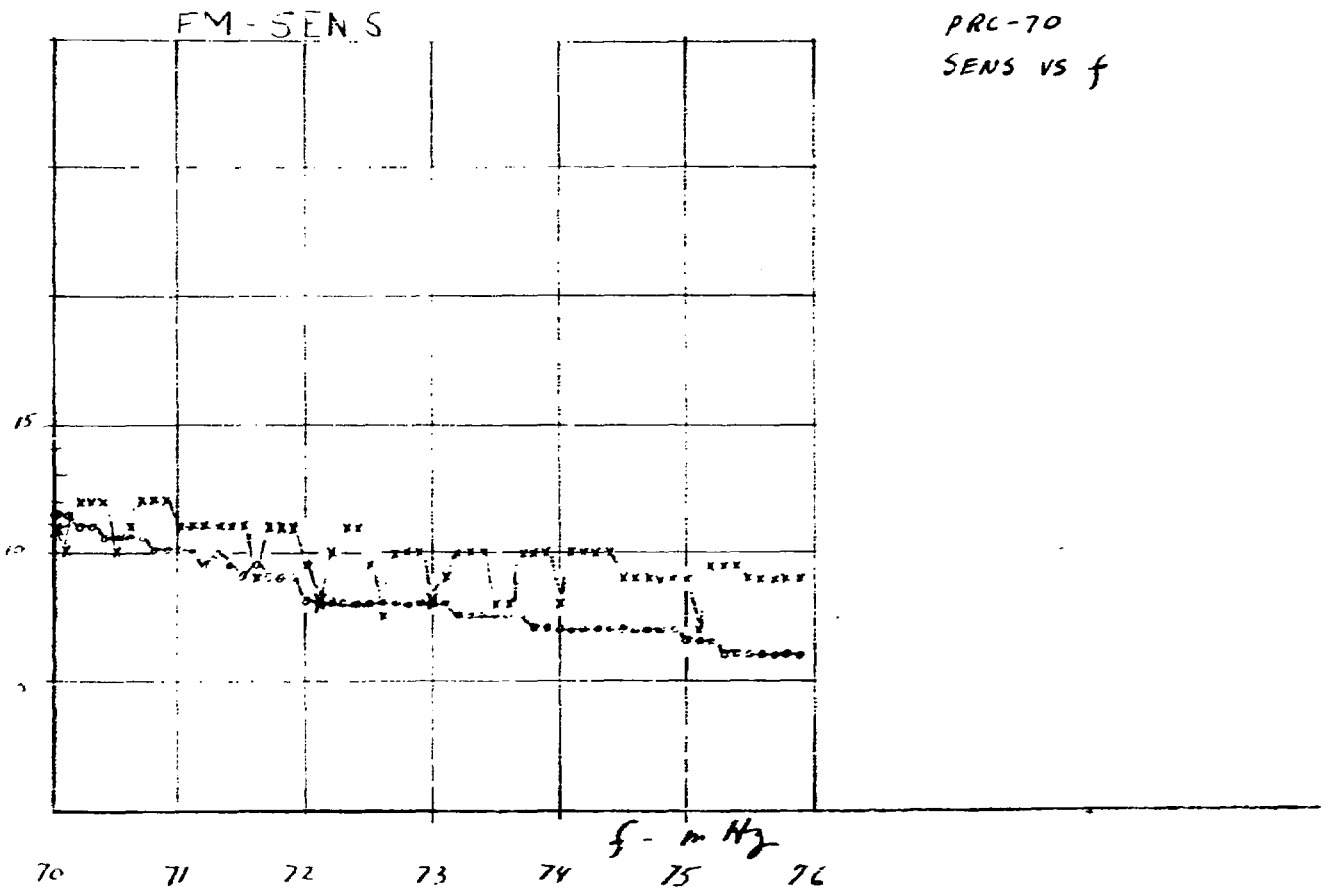

Figure 31. Sensitivity vs. Frequency S/N 8 and 9 (FM) 70 to 76 MHz

AME — 2.5 μV (2 - 20 MHz)
1.95 μV (20 - 76 MHz)
(30% mod. at 1 kHz)

FM — 0.6 μV (30 - 76 MHz)
(8 kHz dev. at 1 kHz)

These plots indicate that the sensitivity is marginal below 3.0 MHz. This problem is due to power supply spurious being injected into the antenna coupler input.

During the quarter, effort was made in this area and, by minor changes in the egg-crate/case grounding techniques, the problem has been almost eliminated. This correction has been incorporated into all systems.

1.1.4 Antenna Matching

During this quarter, much effort was directed toward solving problems in the remaining antenna match areas. These were, in particular, the inability of the system to tune a 15-foot whip below 3.0 MHz, and various frequency "holes" when using the long wire. Modifications were made with the addition of a transformer to use with the long wire antenna which links the impedance to 1000 ohms, and a logic change to the 15-foot whip. These changes have been incorporated into all systems. Table 1 shows the matching capability of the 21 ET/ST systems as measured in actual antennas. These measurements were made approximately 300 feet from any large building at Cincinnati Electronics with the equipment set on the ground.

1.1.5 Desensitization

Figure 32 shows the typical desensitization of the AN/PRC-70 Radio Set. The measurement was made by obtaining a 26 db signal-to-noise ratio at the desired signal and increasing the interfering signal until this output signal-to-noise was degraded by 6 dB.

1.1.6 Wideband Delay

Figure 33 shows the absolute delay of a total system operating in wideband mode (one AN/PRC-70 transmitting and one AN/PRC-70 receiving). The photos in Table 2 show the response of the system at various repetition rates.

TABLE 1. ANTENNA MATCHING

Frequency (MHz)	6 Foot Whip	9 Foot Whip	15 Foot Whip	Doublet Ant	Long Wire 300 Foot
2.0			Y	Y[b]	
3.0		Y	Y	Y	
4.0	Y	Y	Y	Y	
5.0	Y	Y	Y	Y	
6.0	Y	Y	Y	Y	Y
7.0	Y	Y	Y	Y	Y
8.0	Y	Y	Y	Y	Y
9.0	Y	Y	Y	Y	Y
10.0	Y	Y	Y	Y	Y
11.0	Y	Y	Y	Y	Y
12.0	Y	Y	Y	Y	Y
13.0	Y	Y	Y	Y	Y
14.0	Y	Y	Y	Y	Y
15.0	Y	Y	Y	Y	Y
16.0	Y	Y	Y	Y	Y
17.0	Y	Y	Y	Y	Y
18.0	Y	Y	Y	Y	Y
19.0	Y	Y	Y	Y	Y
20.0	N[a]	Y	Y	Y	Y
21.0	Y	Y	Y	Y	Y
22.0	Y	Y	Y	Y	Y
23.0	Y	Y	Y	Y	Y
24.0	Y	Y	Y	Y	Y
25.0	Y	Y	Y	Y	Y
26.0	Y	Y	Y	Y	Y
27.0	Y	Y	Y	Y	Y
28.0	Y	Y	Y	Y	Y
29.0	Y	Y	Y	Y	Y
30.0	Y	Y	Y	Y	Y
31.0	Y	Y			
32.0	Y	Y			
33.0	Y	Y			
34.0	Y	Y			
35.0	Y	Y			
36.0	Y	Y			
37.0	Y	Y			

(a) N = no
(b) Y = yes

TABLE 1. ANTENNA MATCHING - CONT

Frequency (MHz)	6 Foot Whip	9 Foot Whip	15 Foot Whip	Doublet Ant	Long Wire 300 Foot
38.0	Y	Y			
39.0	Y	Y			
40.0	Y	Y			
41.0	Y	Y			
42.0	Y	Y			
43.0	Y	Y			
44.0	Y	Y			
45.0	Y	Y			
46.0	Y	Y			
47.0	Y	Y			
48.0	Y	Y			
49.0	Y	Y			
50.0	Y	Y			
51.0	Y	Y			
52.0	Y	Y			
53.0	Y	Y			
54.0	Y	Y			
55.0	Y	Y			
56.0	Y	Y			
57.0	Y	Y			
58.0	Y	Y			
59.0	Y	Y			
60.0	Y	Y			
61.0	Y	Y			
62.0	Y	Y			
63.0	Y	Y			
64.0	Y	Y			
65.0	Y	Y			
66.0	Y	Y			
67.0	Y	Y			
68.0	Y	Y			
69.0	Y	Y			
70.0	Y	Y			
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74.0	Y	Y			
75.0	Y	Y			
76.0	Y	Y			

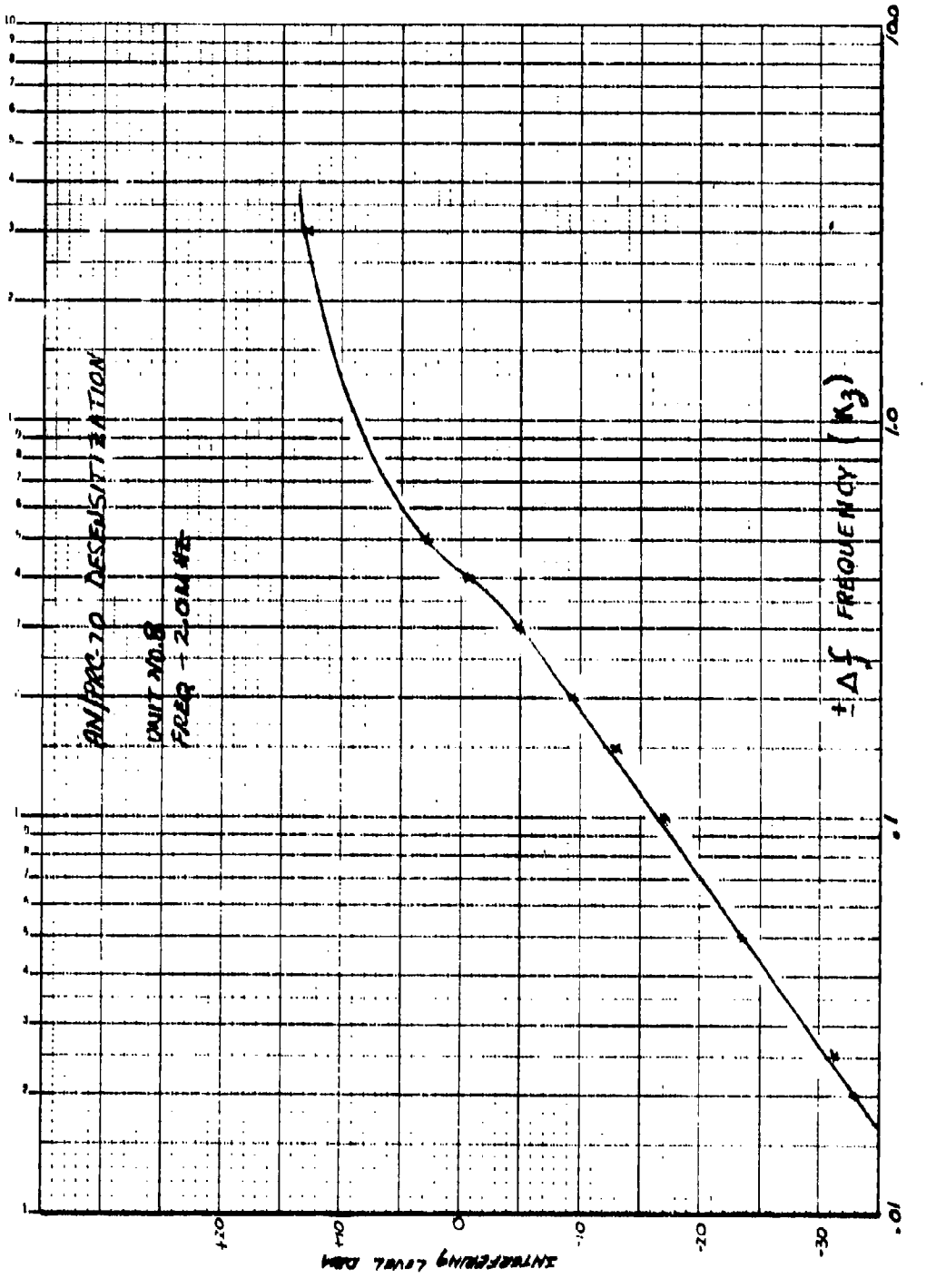


Figure 32. AN/PRC-70 Desensitization Data

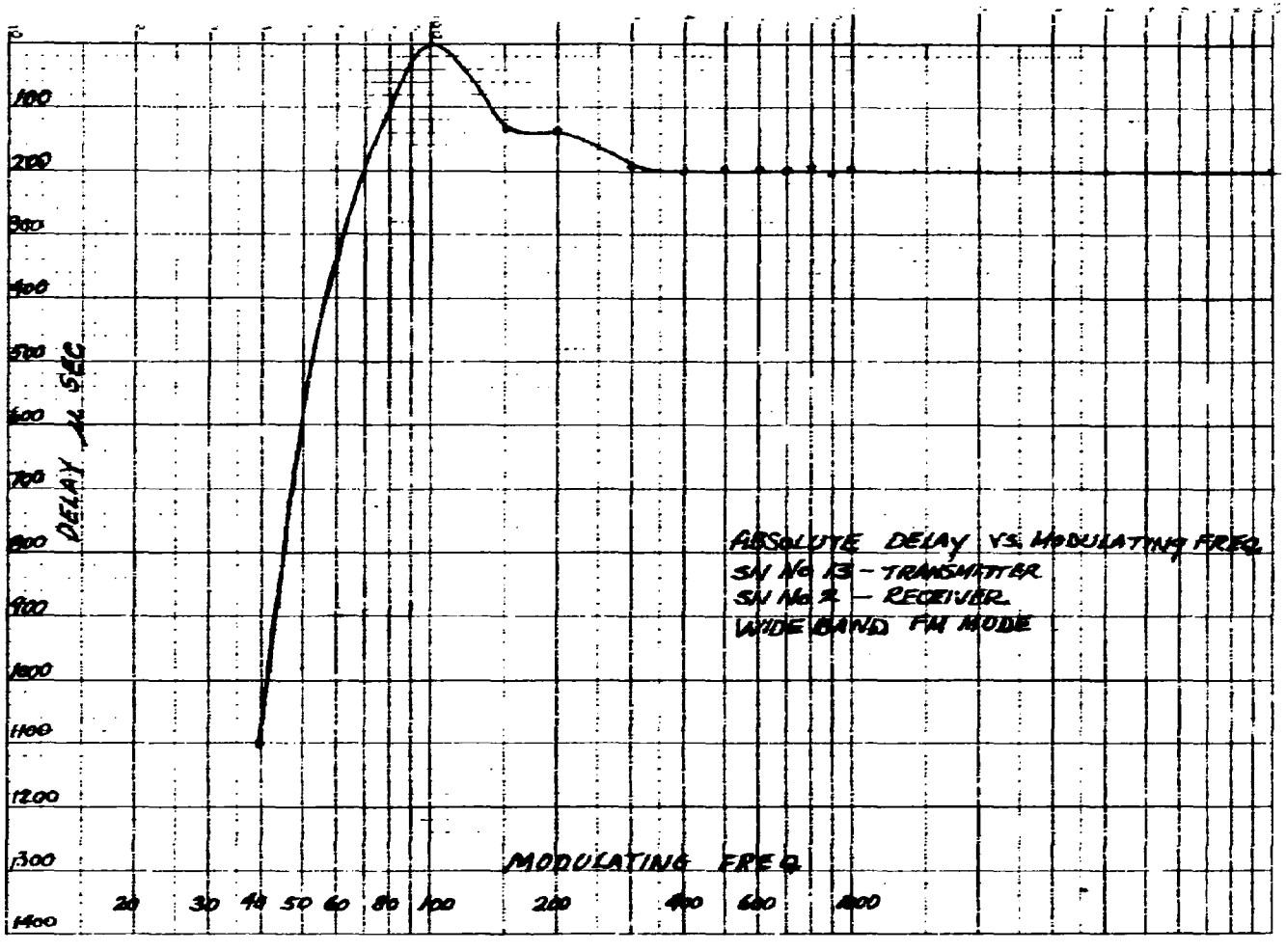
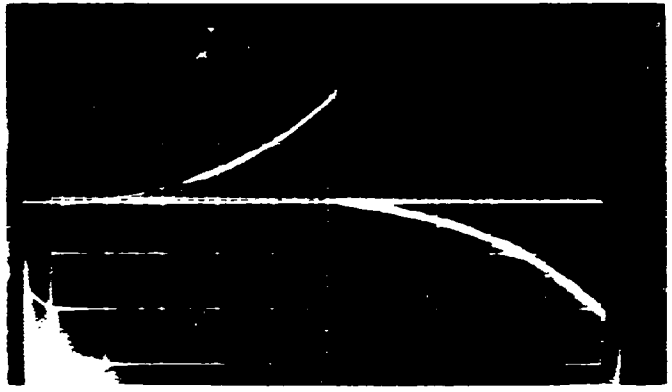


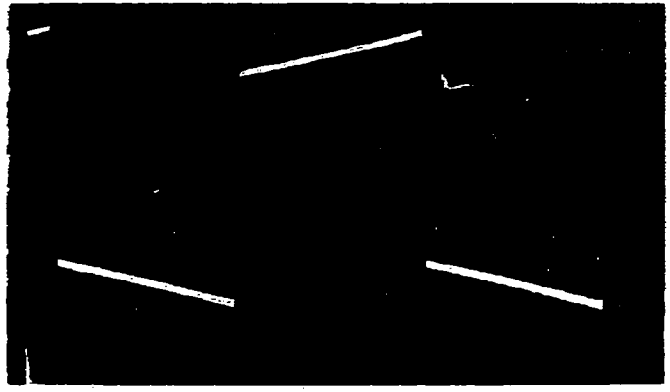
Figure 33. Absolute Delay vs. Modulating Frequency

TABLE 2. SYSTEM RESPONSE VS. PULSE REPETITION RATE

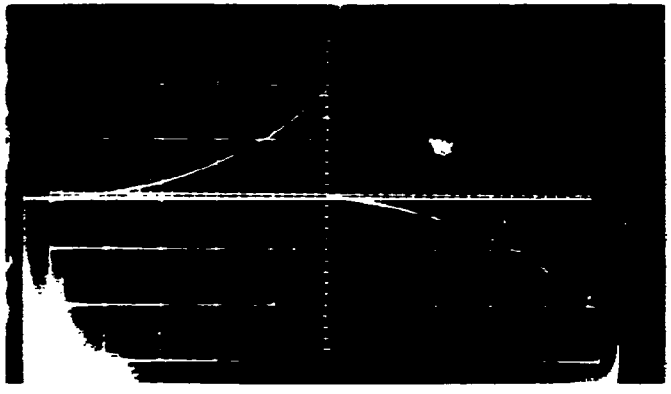
PRC-70
FM-5.6 KHZ DEV.



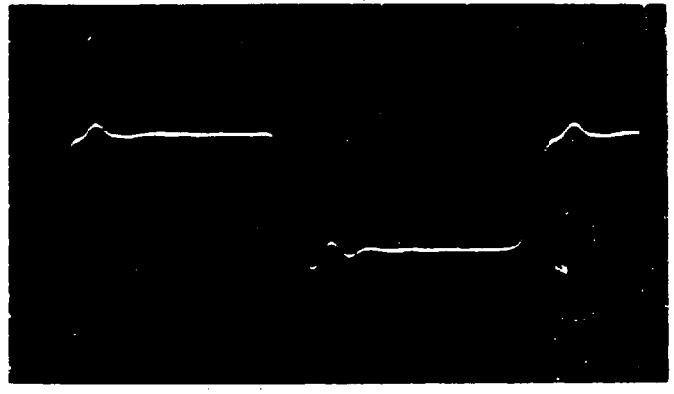
PULSE RATE - 10 HZ



PULSE RATE - 74 HZ



PULSE RATE - 10 Hz

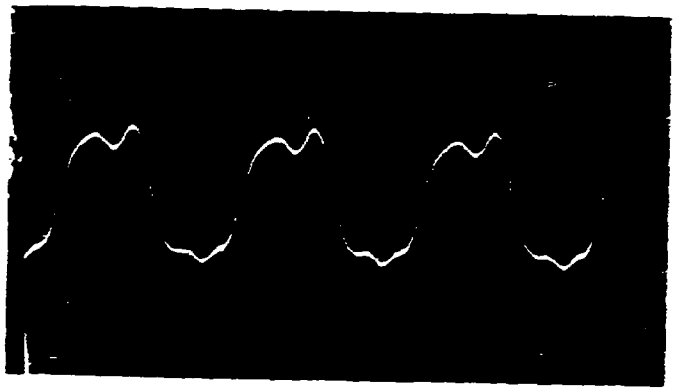


PULSE RATE - 1.12/ KHZ

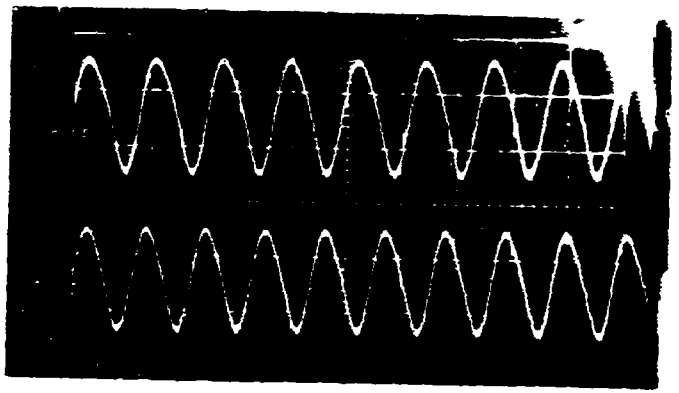
TABLE 2. SYSTEM RESPONSE VS. PULSE REPETITION RATE – CONT

PRC-70

FM-5.6 KHZ



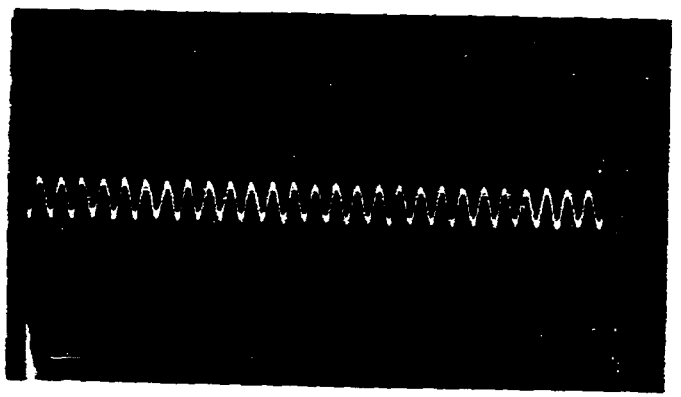
PULSE RATE - 3.0 KHZ



PULSE RATE - 8.0 KHZ

PULSE RATE - 9.0 KHZ

PULSE RATE - 6.0 KHZ



PULSE RATE - 13.0 KHZ

1.1.7 GRA-71 Operation

The photos in Table 3 show the operation of the GRA-71 between two AN/PRC-70 radio equipments. The key line is the output of the GRA-71 entering Radio A; the RF output is that of Radio A which enters Radio B antenna port; the audio output is that of Radio B which enters the decode device or the GSH-6.

Tests were also conducted to verify the operation of the GRA-71 in conjunction with the GSH-6.

1.1.8 CW Mode Operation

During this quarter, a problem was uncovered in the turn-around time of the AN/PRC-70 when operating in CW mode. The problem was that the first character may not be transmitted when starting a message. This was due to a receive-to-transmit turn-around of 100 milliseconds. Upon investigation it was found that a transient was getting into the transmit audio section and shutting off an operational amplifier for this period. Filtering was added to the power line plus a minor revision of the switching to alleviate this problem. The turn-around time is now being measured at less than 5 milliseconds which is more than sufficient to meet the operational requirement.

2.0 SYSTEM TESTS (ENVIRONMENTAL)

The following environmental tests have been completed.

2.1 TEMPERATURE TESTS

Figures 34 to 48 show the typical power output and sensitivity being achieved while operating over temperature extremes.

2.2 FUNGUS

Fungus testing has been completed. The only identifiable growth was noted on the rubber protective caps used on the 2-wire antenna input connector. No corrective action is planned.

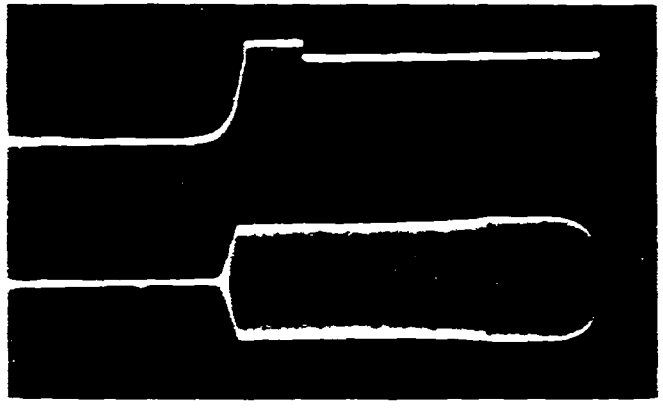
2.3 HUMIDITY

Humidity testing has been completed. The unit performed satisfactorily during this test. A problem developed where excessive pitting of the conformal coating was observed on all modules. Investigation has shown that this phenomenon occurs when proper cleaning is not accomplished before coating. Corrective action will be taken on all future systems.

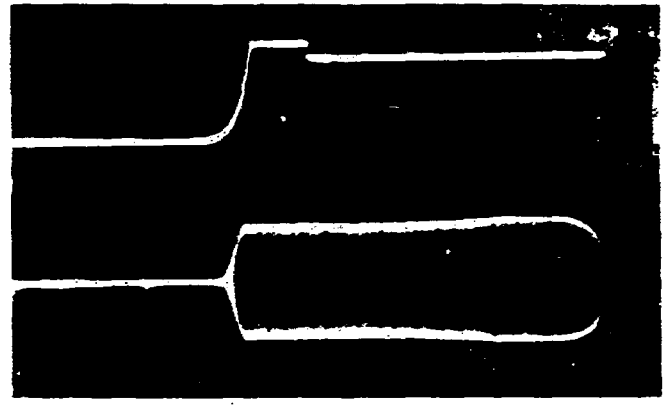
TABLE 3. OPERATION OF THE GRA-71 BETWEEN TWO AN/PRC-70 RADIO SETS

PRC-70 WITH GRA-71

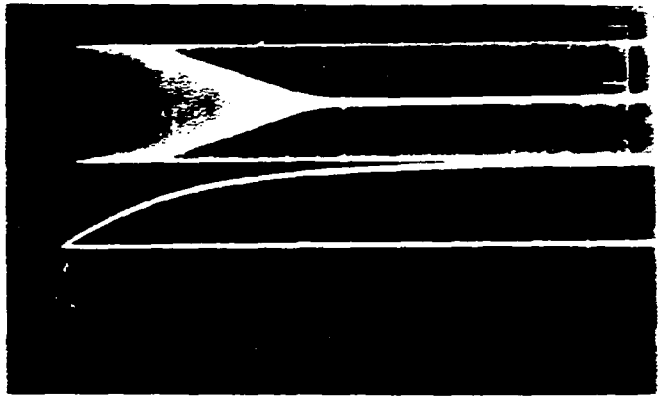
IDY SIGNAL



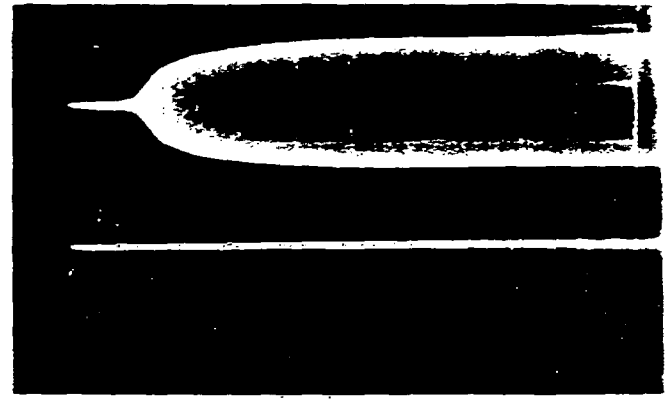
0.5 MSEC/DIV



0.5 MSEC/DIV



50 μSEC/DIV

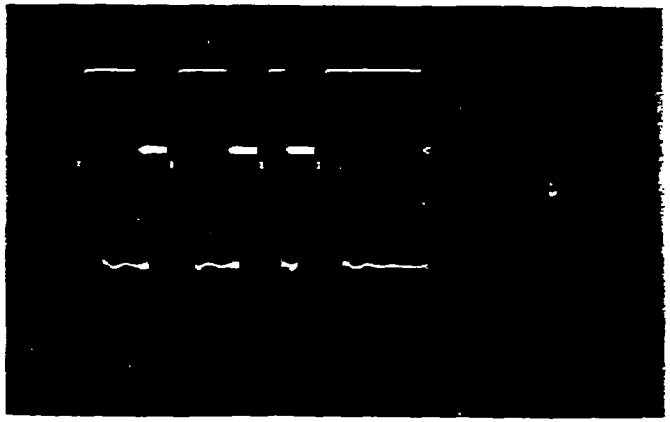


0.1 MSEC/DIV

TABLE 3. OPERATION OF THE GRA-71 BETWEEN TWO AN/PRC-70 RADIO SETS - CONT

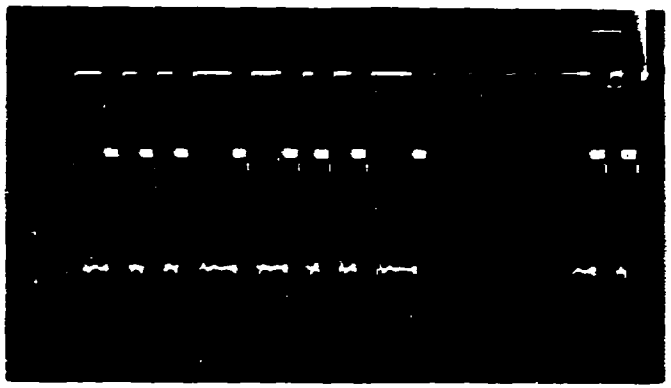
PRC-70 WITH GRA-71

(CODE)



10 MS/DIV

10 MS/DIV



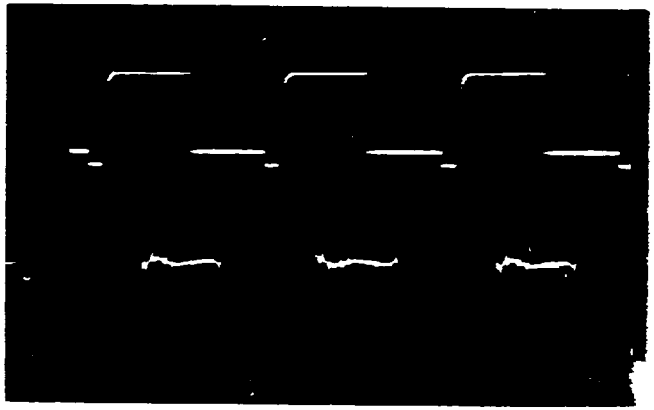
10 MS/DIV

5 MS/DIV

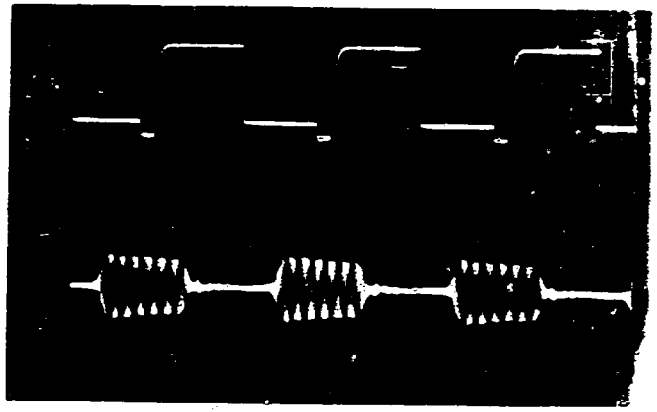
TABLE 3. OPERATION OF THE GRA-71 BETWEEN TWO AN/PRC-70 RADIO SETS - CONT

PRC-70 WITH GRA-71

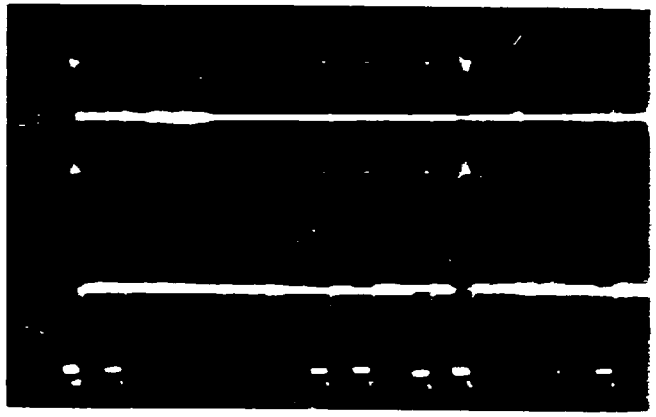
IDY SIGNAL



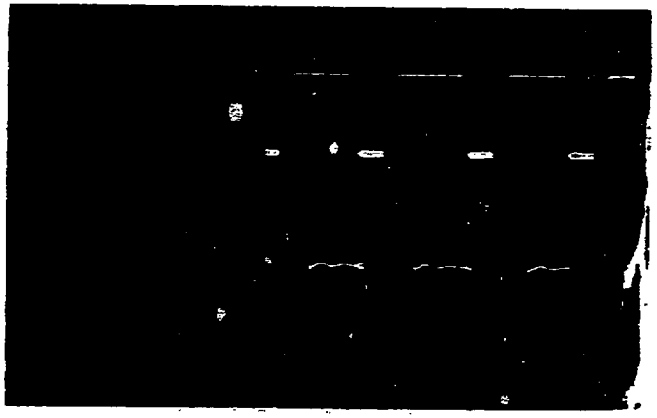
2 MS/DIV



2 MS/DIV



10 MS/DIV



5 MS/DIV

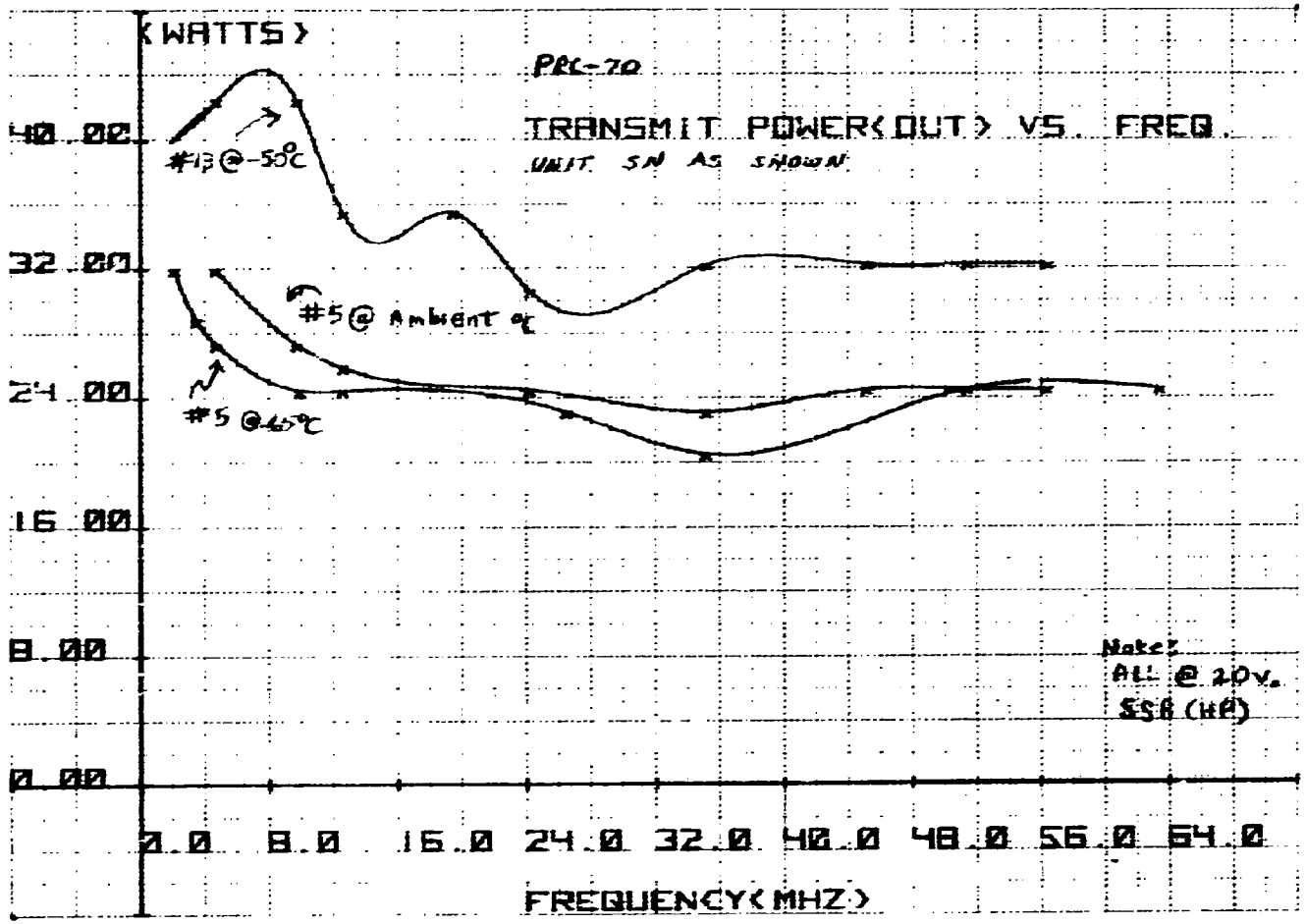


Figure 34. Transmit Power (Out) vs. Frequency S/N 13 at –50°C, S/N 5 at ambient °C, S/N 5 at –65°C

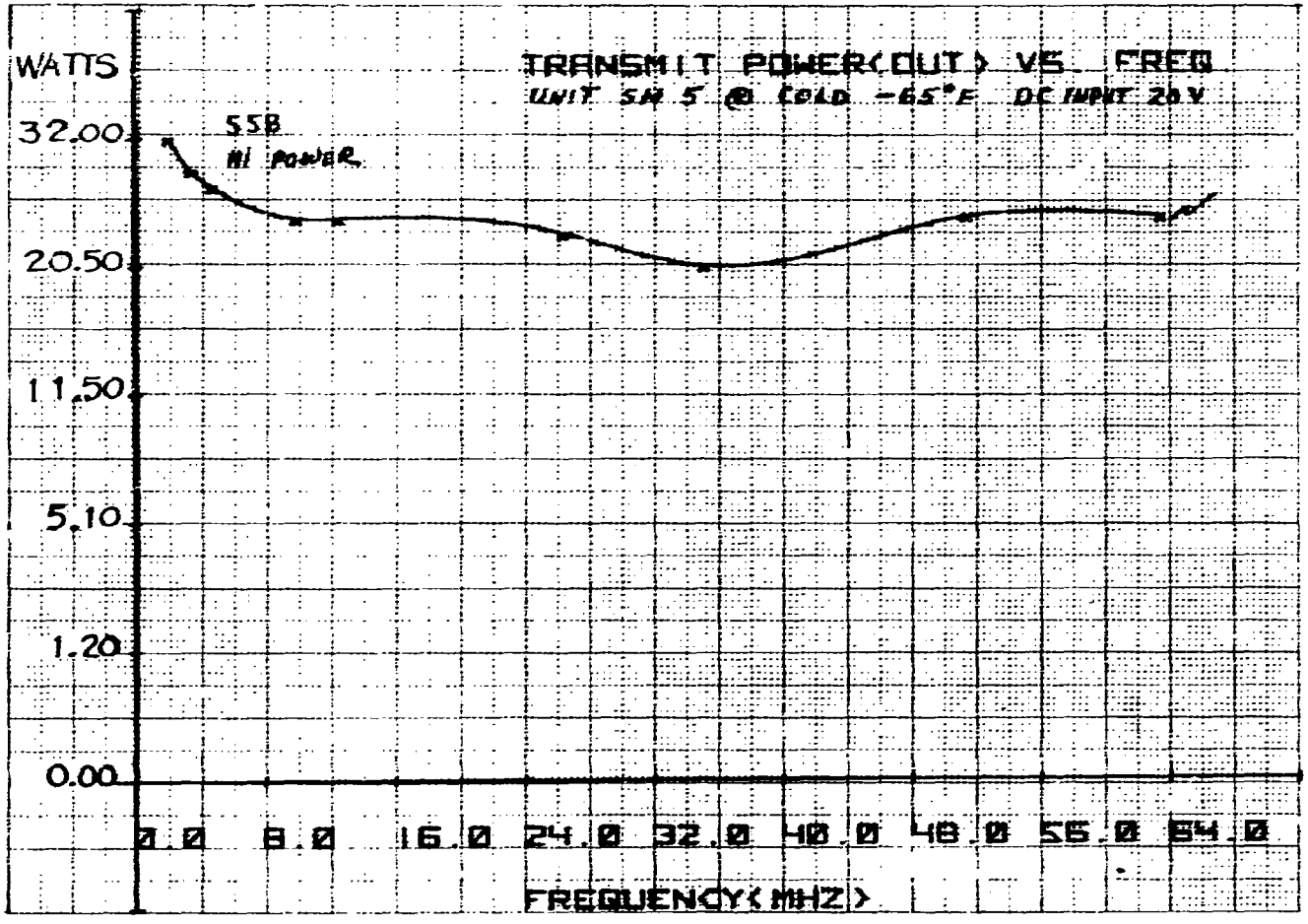


Figure 35. Transmit Power (Out) vs. Frequency SSB High Power

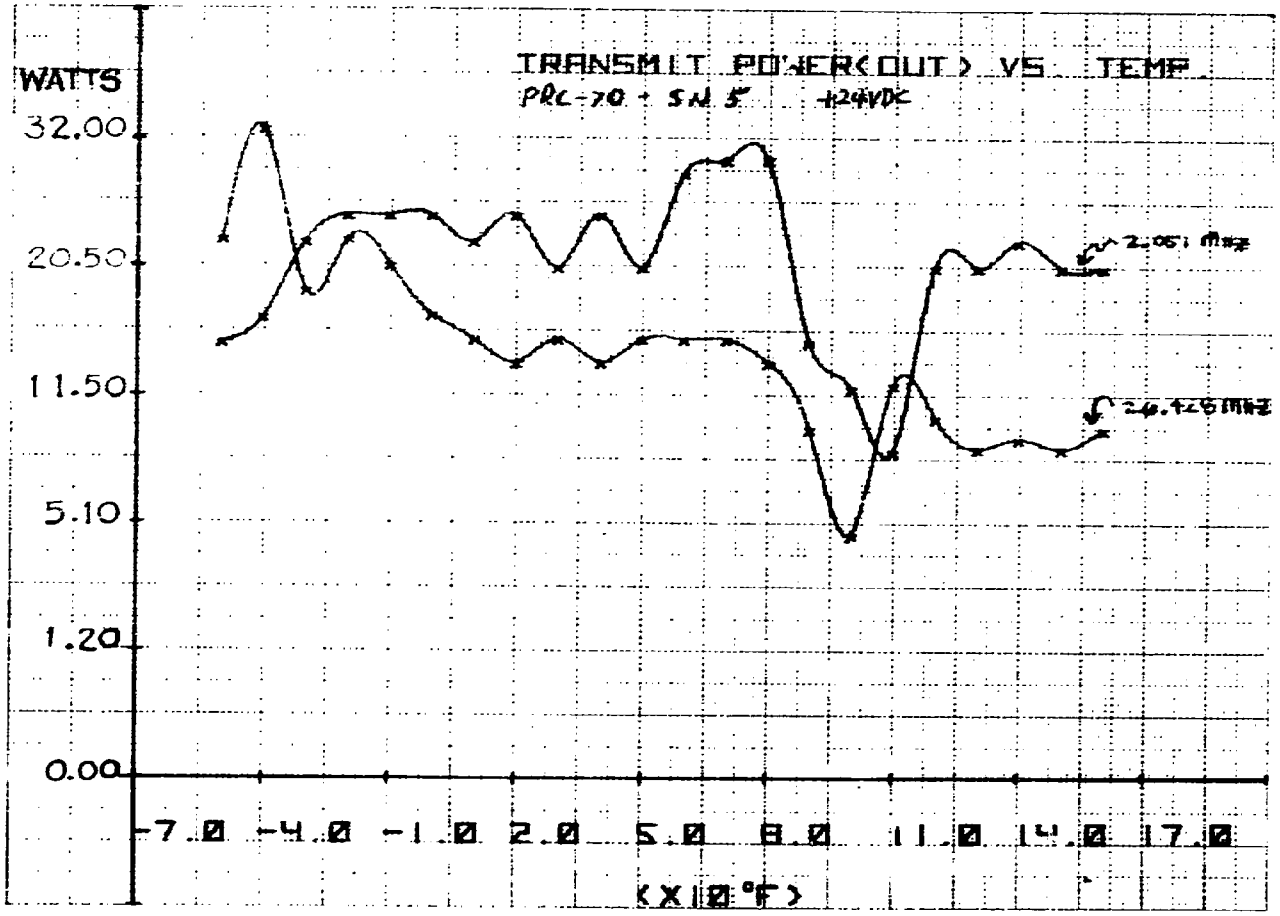


Figure 36. Transmit Power (Out) vs. Temperature – 2.051 MHz & 26.428 MHz

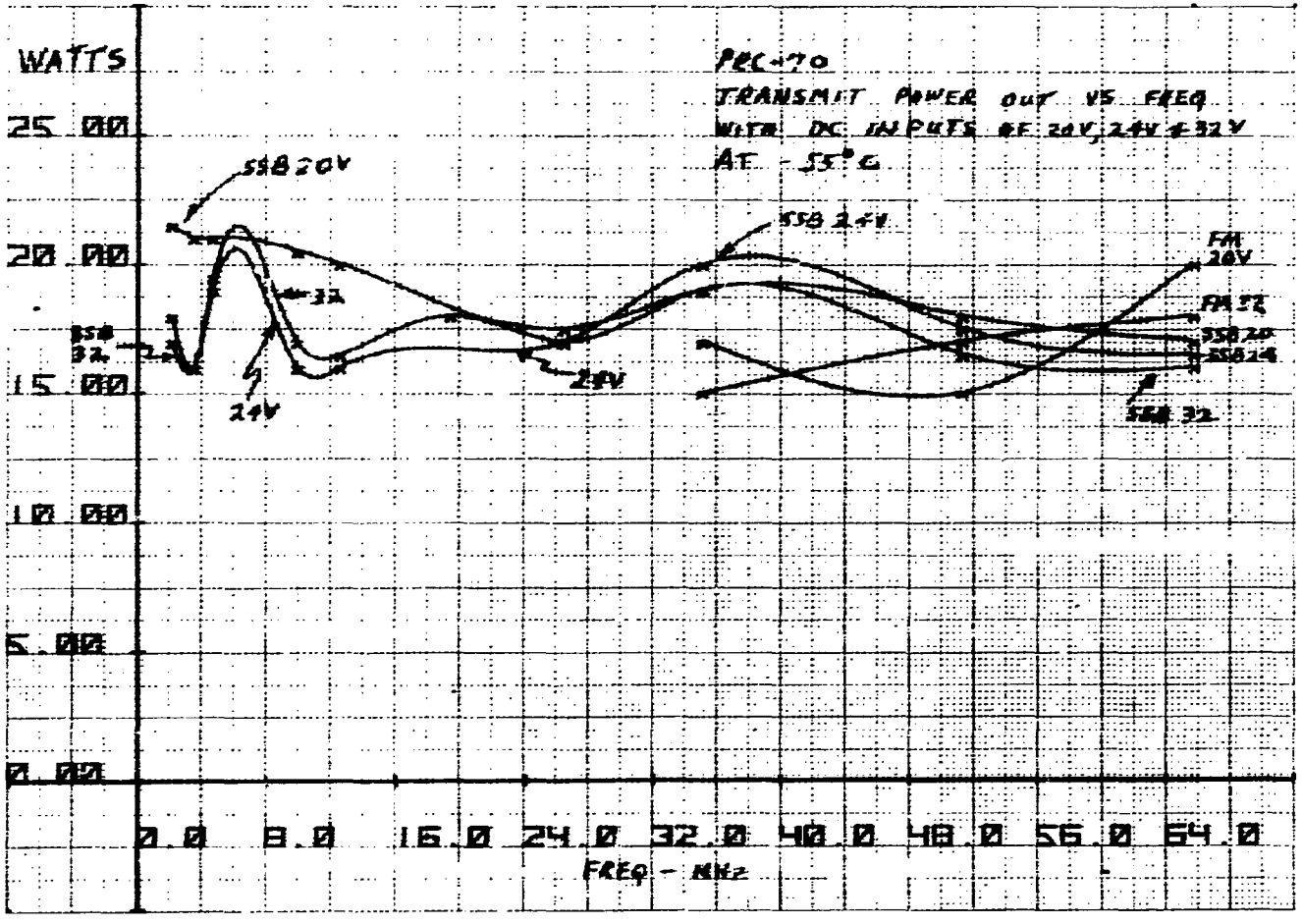


Figure 37. Transmit Power (Out) vs. Frequency - DC Inputs of 20V, 24V & 32V at -55°C

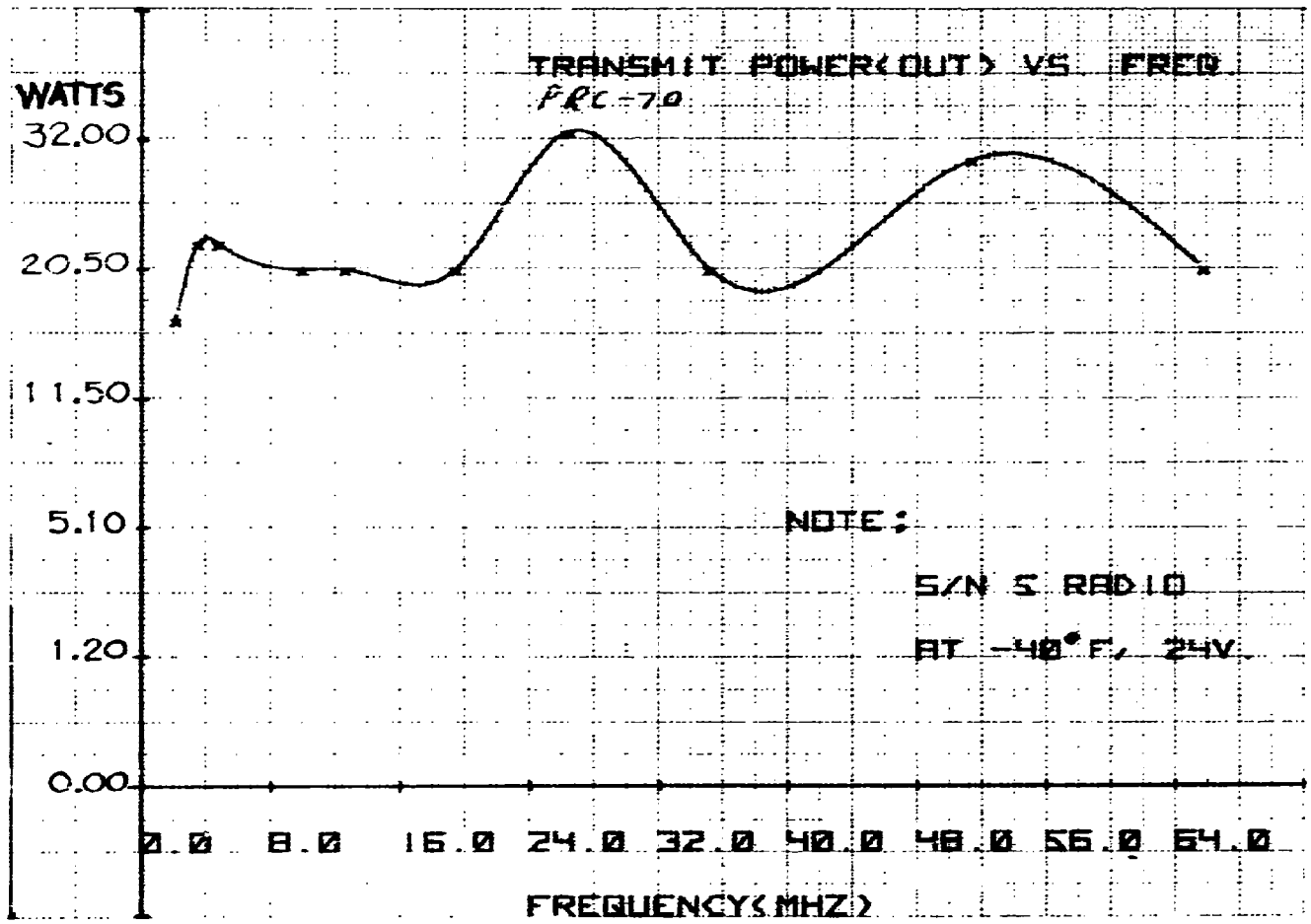


Figure 38. Transmit (Out) vs. Frequency – S/N 5 at –40°F, 24V

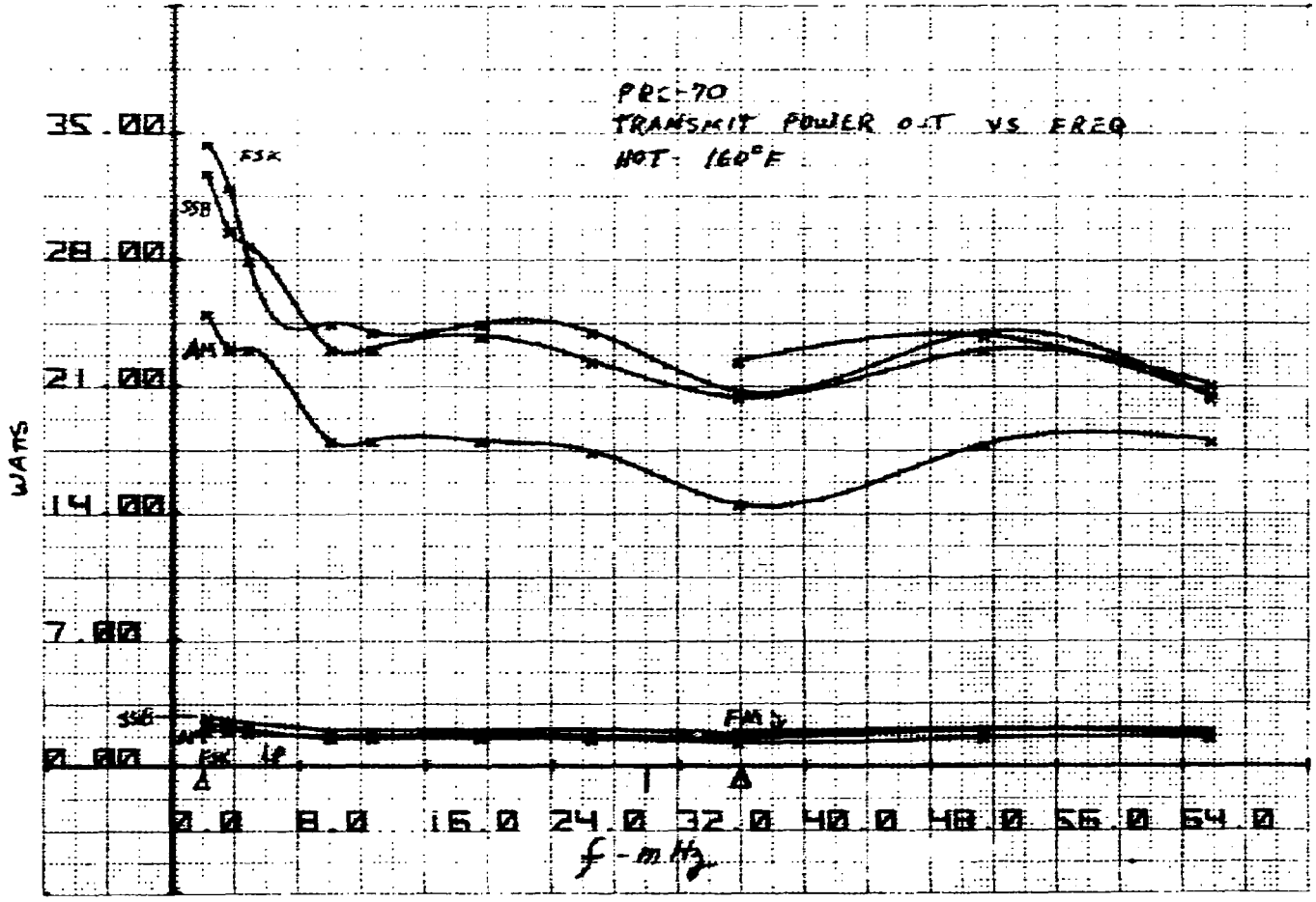


Figure 39. Transmit Power (Out) vs. Frequency – Hot (160°F)

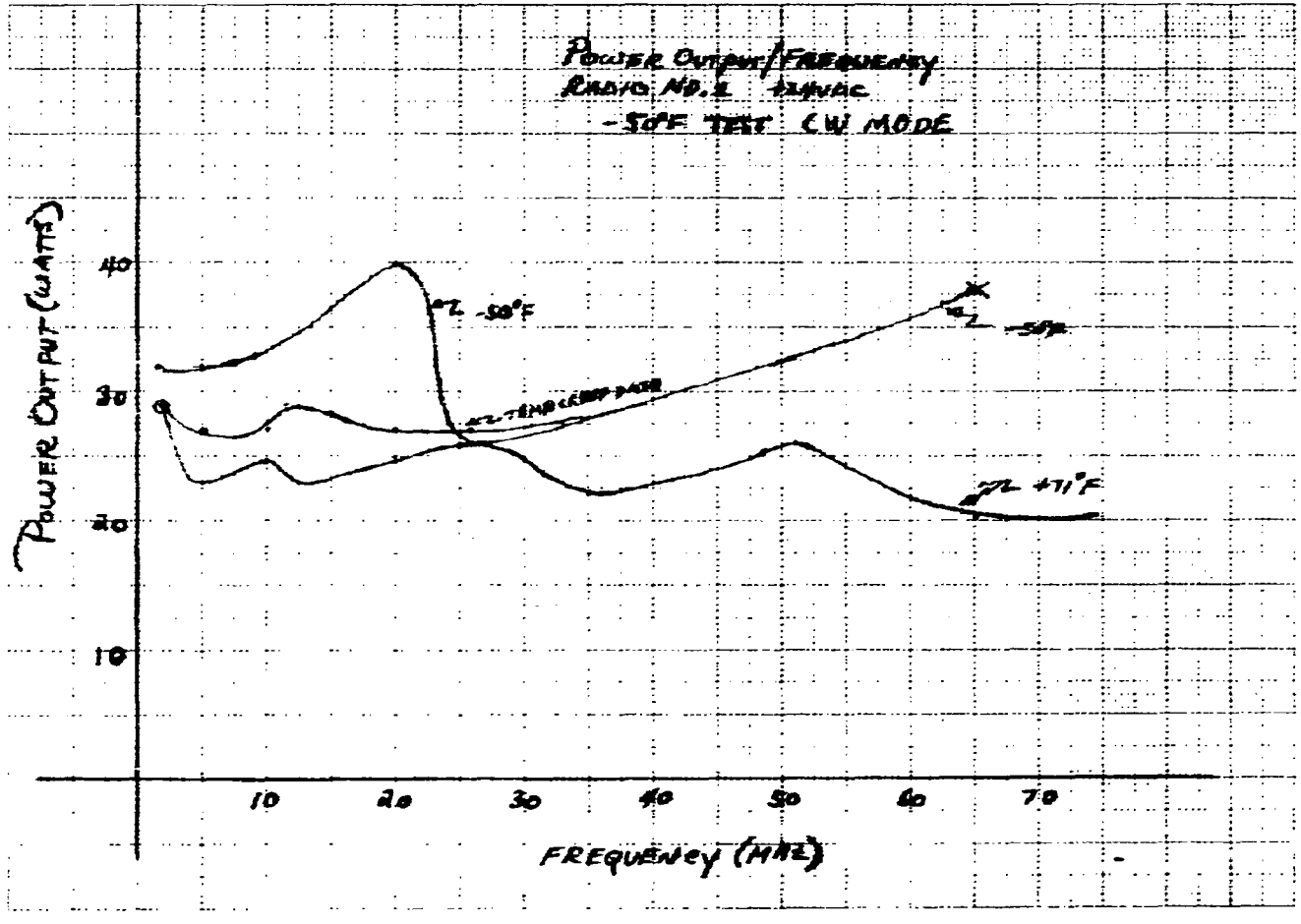


Figure 40. Transmit Power (Out) vs. Frequency – +24 VDC, –50°F

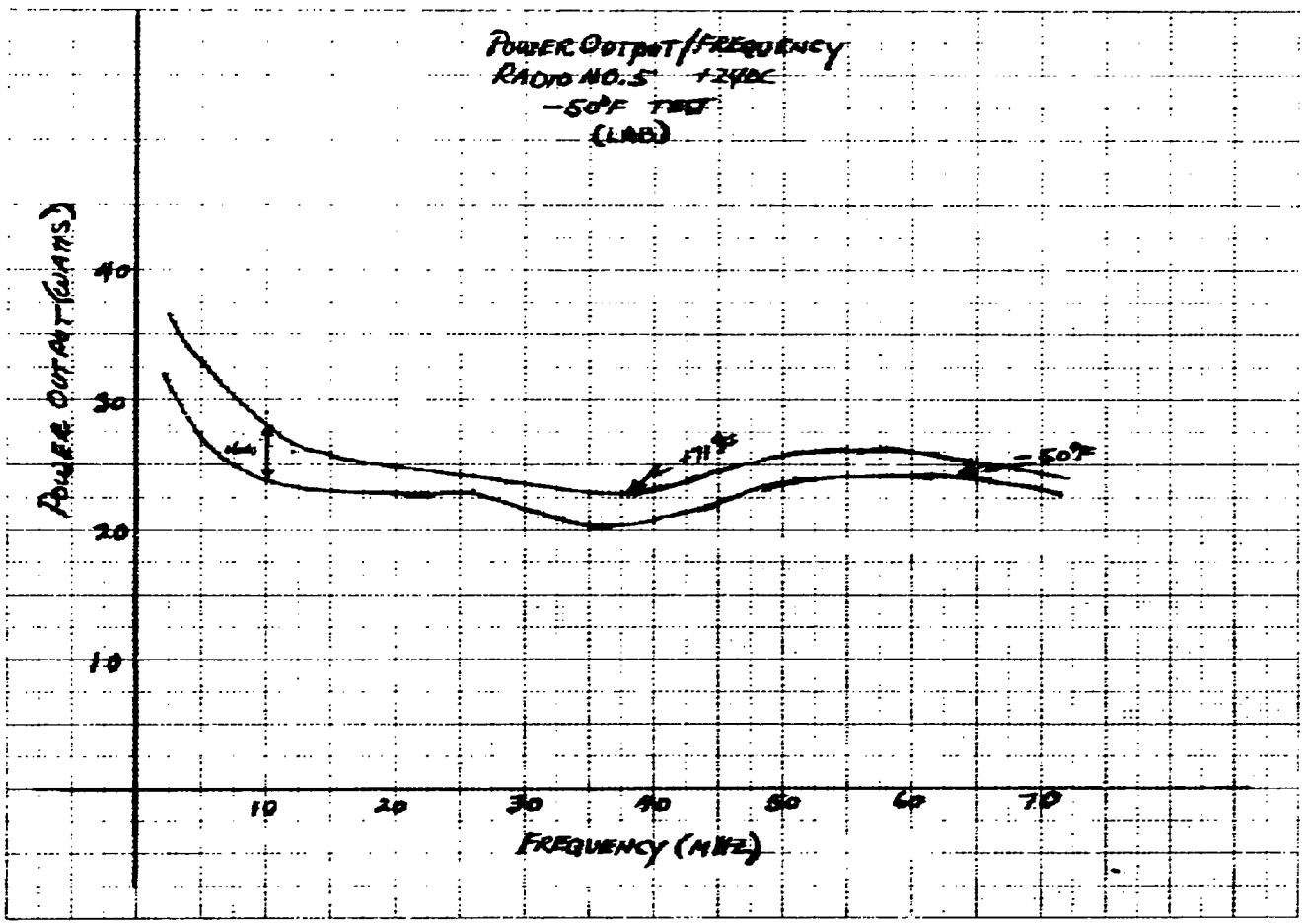


Figure 41. Transmit Power (Out) vs. Frequency – S/N 5 +24 VDC, -50°F

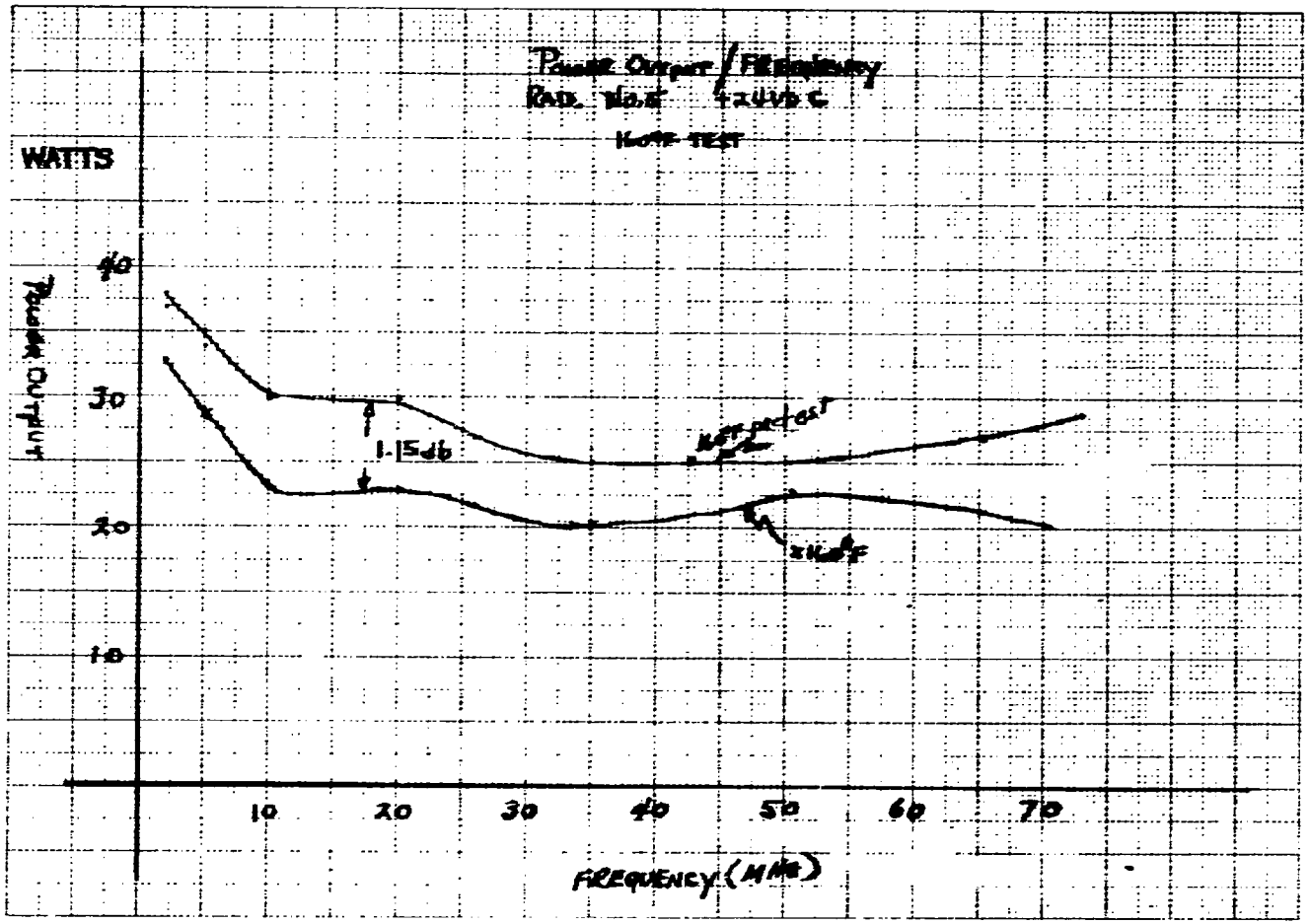


Figure 42. Transmit Power (Out) vs. Frequency – +24 VDC, 160°F

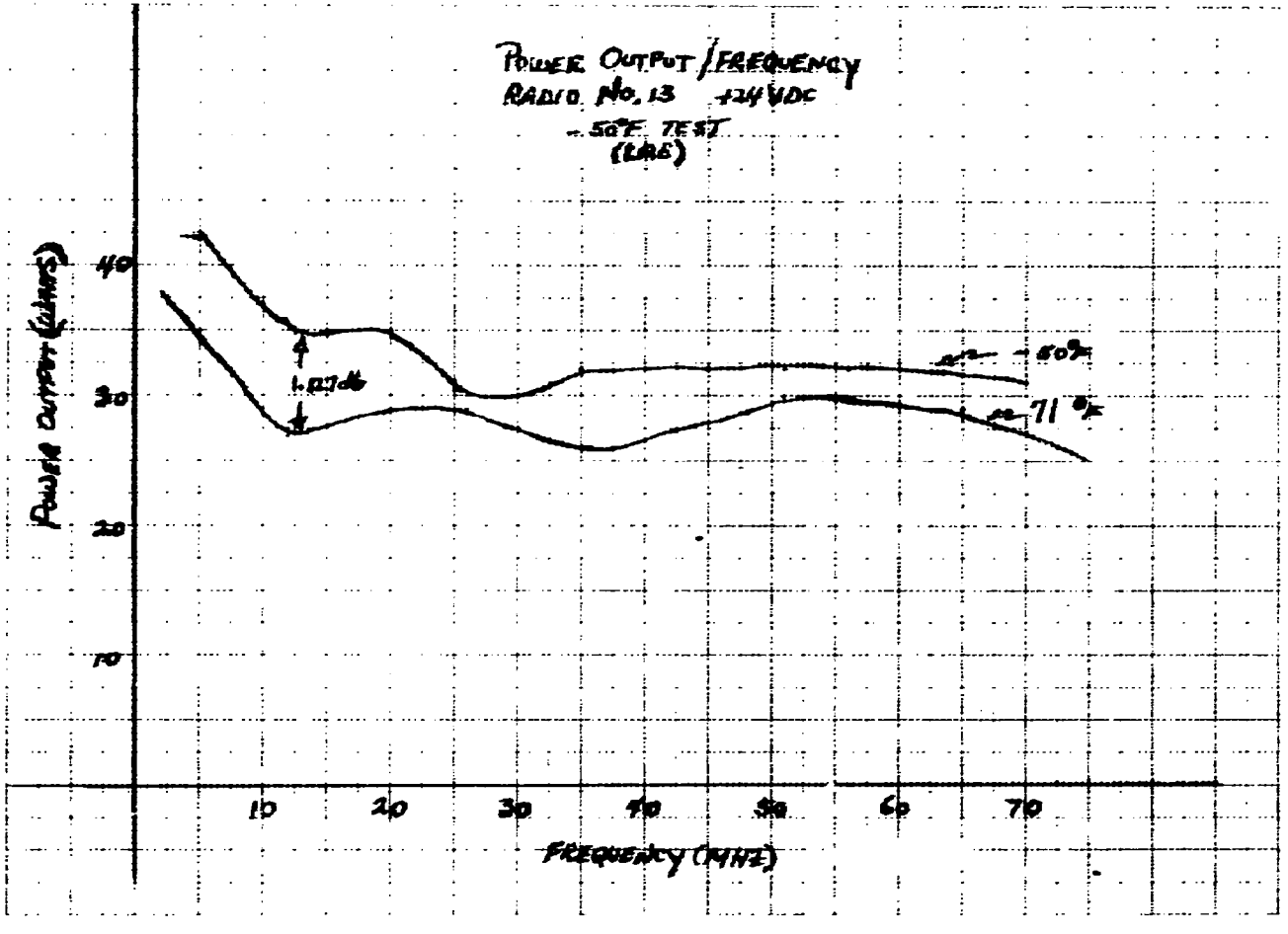


Figure 43. Transmit Power (Out) vs. Frequency – S/N 13, +24 VDC, -50°F

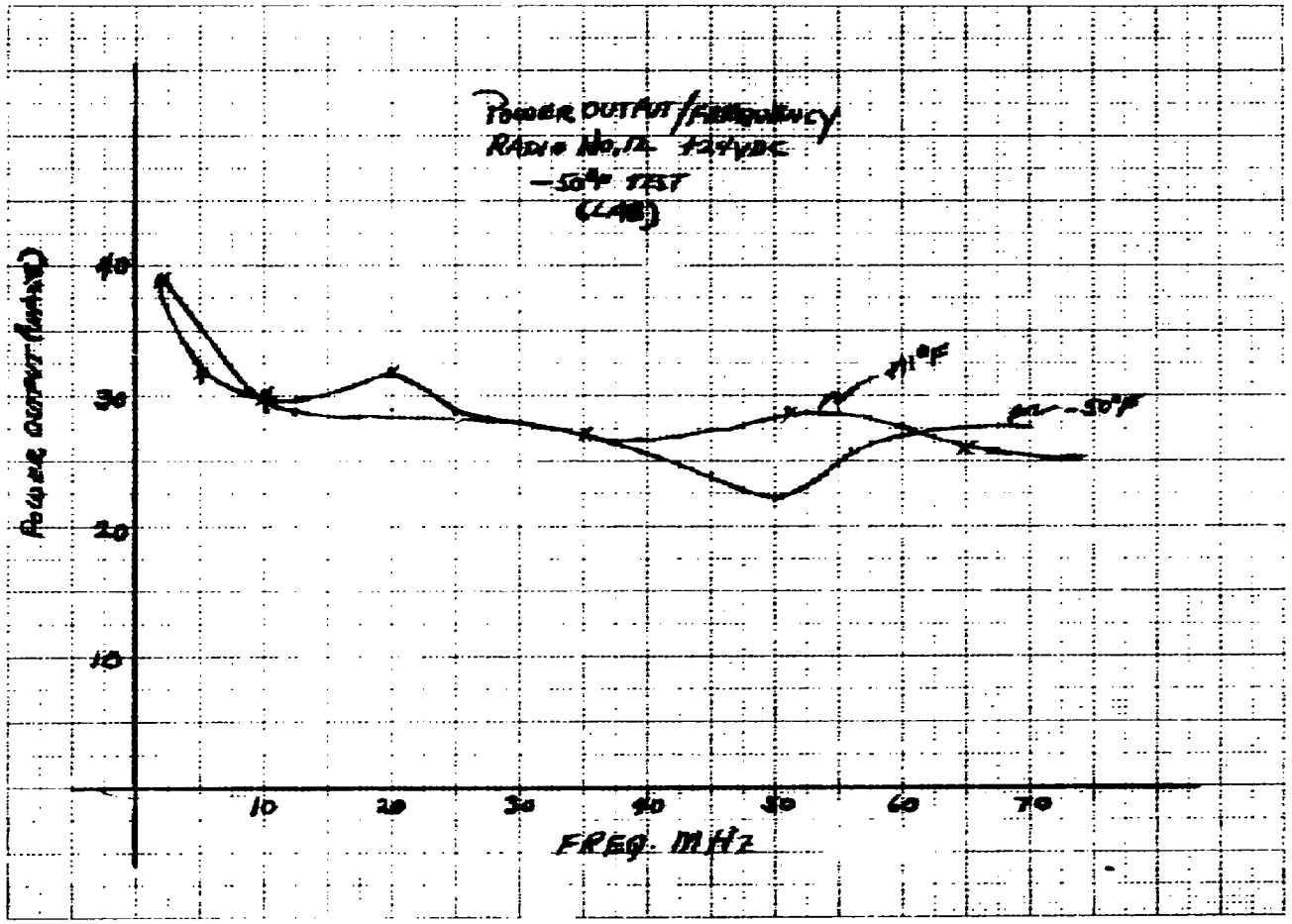


Figure 44. Transmit Power (Out) vs. Frequency – S/N 12 +24 VDC, -50°F

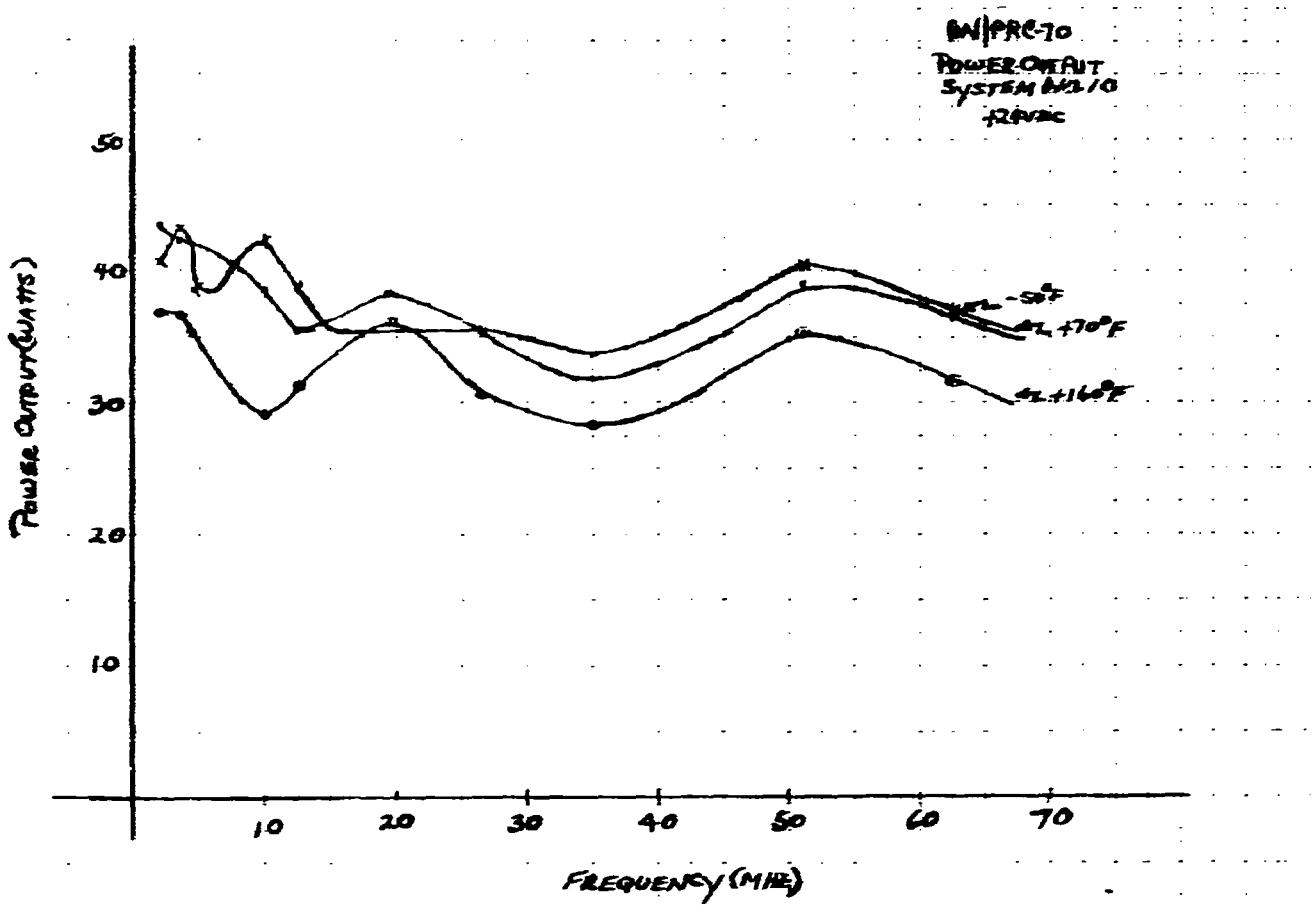


Figure 45. Transmit Power (Out) vs. Frequency – S/N 10, +24 VDC

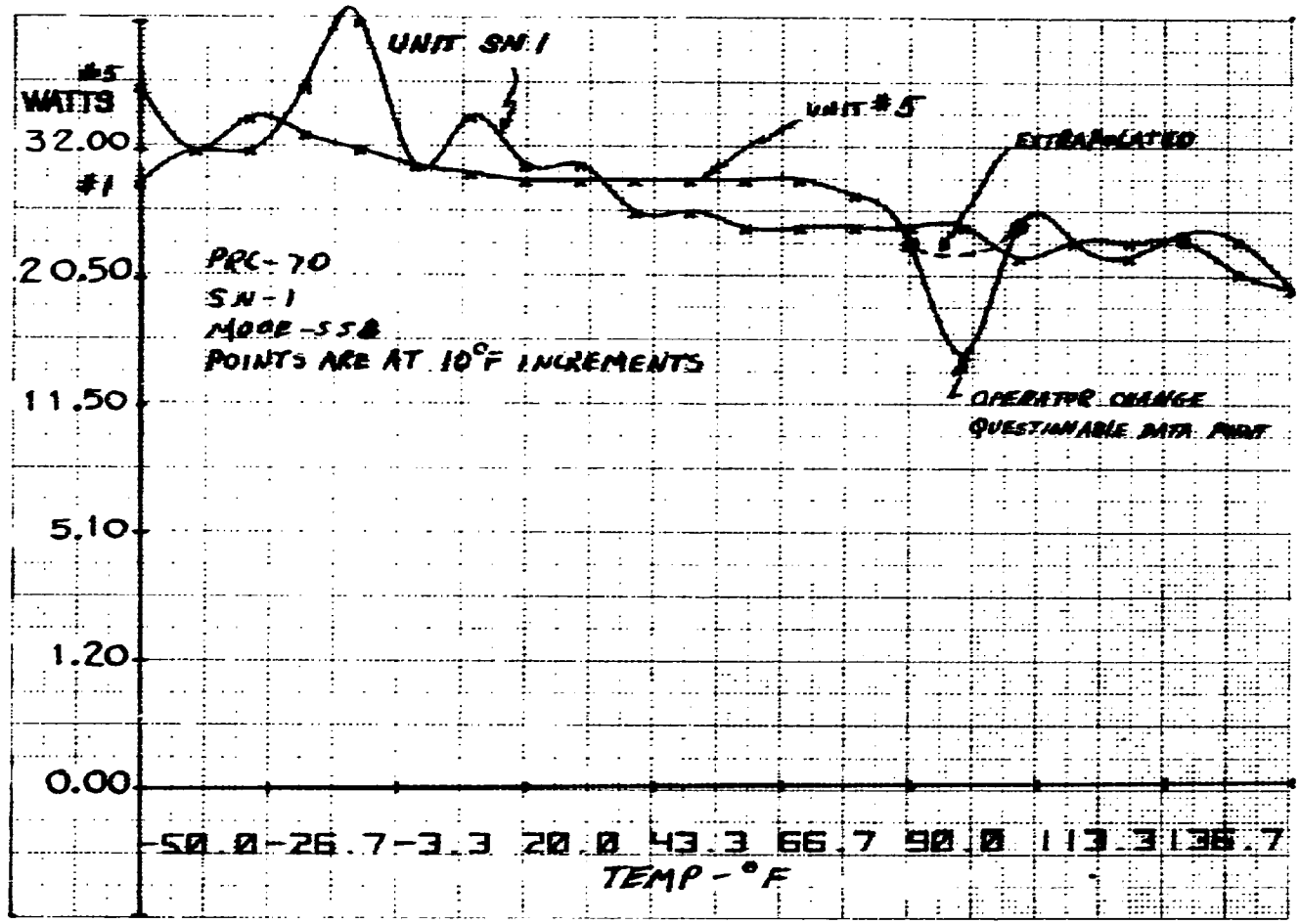


Figure 46. Transmit Power (Out) vs. Temperature

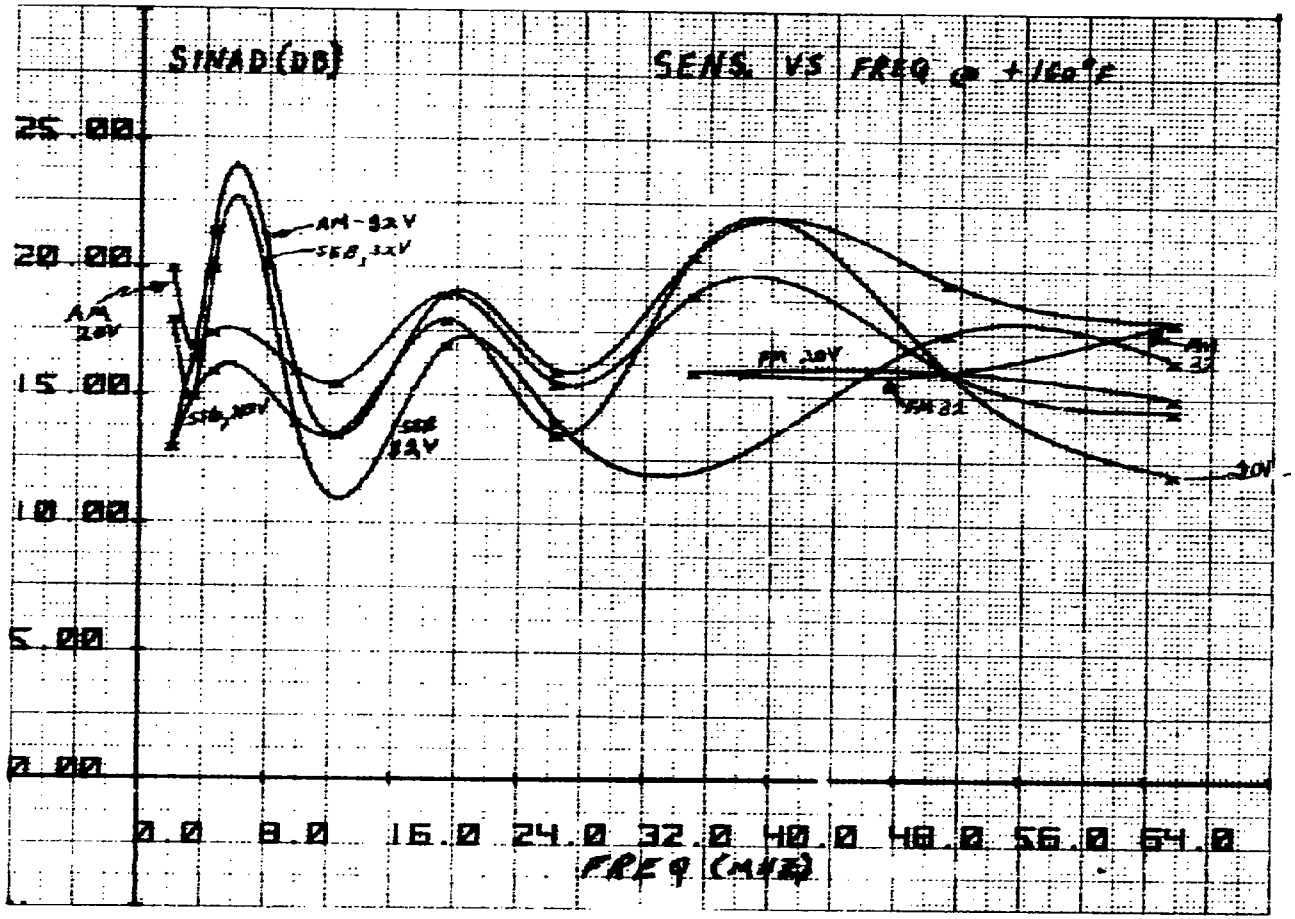


Figure 47. Sensitivity vs. Frequency at +160°F

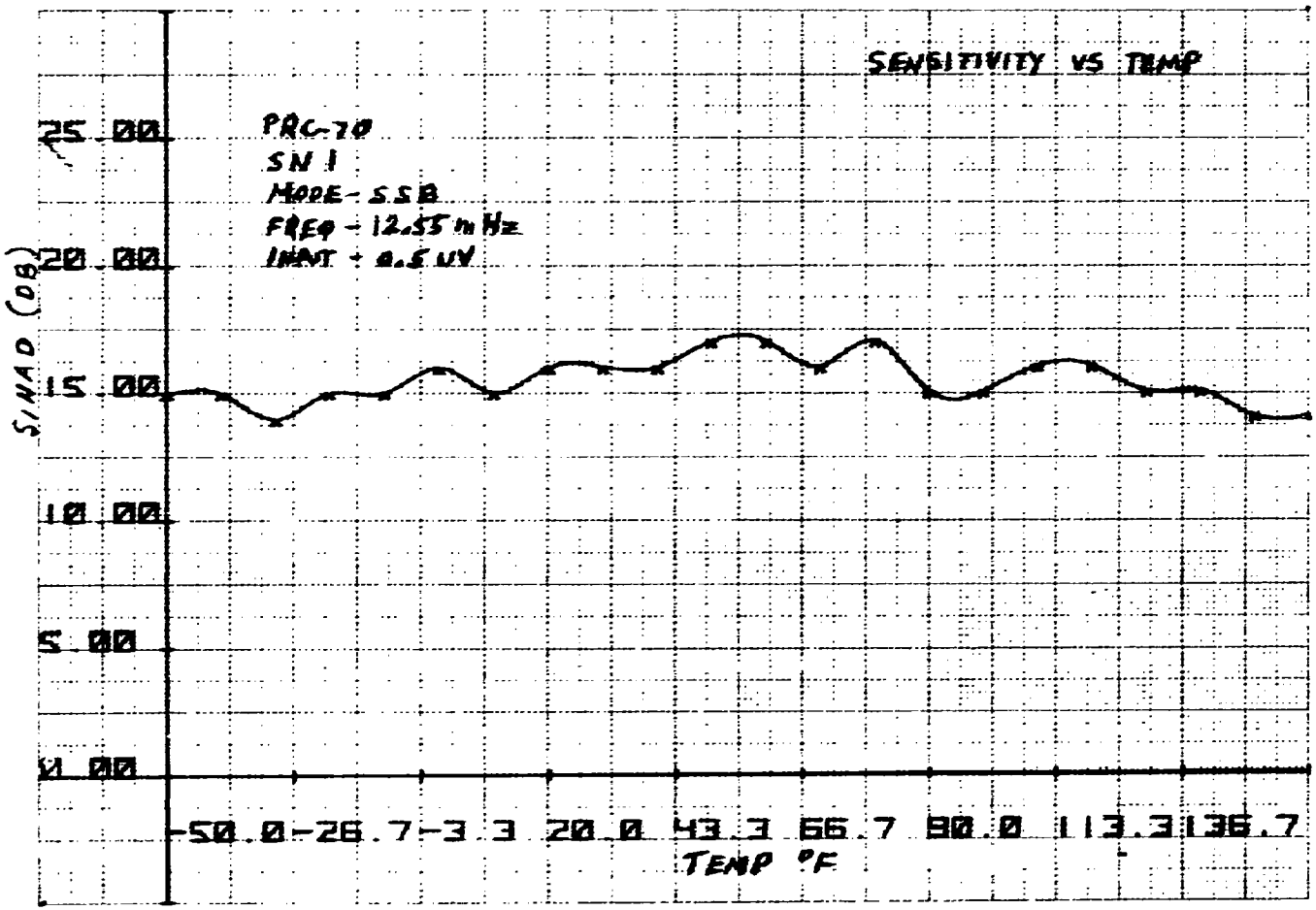


Figure 48. Sensitivity vs. Temperature

2.4 SALT FOG

The Salt Fog Test has been completed with no detrimental effects.

2.5 VEHICULAR BOUNCE

Two units have been subjected to and have passed the Vehicular Bounce Test.

2.6 DROP TEST

Unit No. 6 has been subjected to the Drop Test. The system failed in the following areas:

1. Extensive movement and bending of the "egg-crate".
2. Coils broken in the power supply.
3. Coils broken in the antenna coupler.

Corrective action was taken on Serial No. 7. These corrective actions consisted of:

1. Additional fasteners added to hold egg-crate to the case and top cover.
2. Tie downs added to the power supply coils.
3. Change in material of the screws holding the antenna coupler in place.

The above corrective actions were incorporated into Unit No. 7 which was again subjected to the Drop Test.

The corrective actions are considered adequate to enable compliance with the Drop Test requirement.

3.0 MECHANICAL

The weight reduction effort has been completed. All drawings have been updated for the procurement package.

4.0 MODULE STATUS

All modules have been completed. The only changes added were to correct MIL-STD-275 deficiencies.

4.1 ANCILLARY ITEMS

All Ancillary Items are in-house and being readied for shipment.